

INTRODUCTION

As part of its 2007 – 2011 Strategic Plan the County Commissioners adopted the following Infrastructure strategic goal:

By January 2009, adopt a comprehensive energy plan for Frederick County Government, which establishes definitive goals (annual) to reduce the County's use of non-renewable energy over a 15-year period in its office buildings, facilities and vehicle fleet by 50 percent or more.

The Management Services Division was assigned the lead role for this strategic goal by the County Manager. The Division established three work groups to develop strategies to achieve the strategic goal focusing on the following sectors of County government energy consumption:

- Buildings
- Fleet
- Division of Utilities and Solid Waste (DUSWM) Facilities

Management Services conducted an all-day Energy Planning Session for Division Directors in April 2008 to educate top-level managers on the need to increase energy efficiency and reduce the use of non-renewable energy. As a part of the workshop, the participants were asked to draft a short statement to the Board of County Commissioners that responded to the strategic goal. The six planning session teams agreed that the following statement articulated the response of all the participants:

It is the goal of the Frederick County Government to identify, promote, and expand the use of cost-effective renewable energy. These efforts will utilize energy conservation, alternative fuels, new energy-efficient technology, public awareness, and staff education to meet the 50 percent reduction in non-renewable energy use in 15 years.

Comprehensive Energy Plan Outcome

The recommendations in this Comprehensive Energy Plan include a combination of a) energy conservation, b) conversion to renewable fuel sources, and c) generation of renewable energy. If all the recommendations in the Plan were implemented, the following reductions by energy source would be possible:

<u>Energy Source</u>	<u>%-Reduction of Non-Renewable Energy</u>
Electricity (kWh)	-100%
Natural Gas (therms)	-39%
Gasoline & Diesel fuel (gals)	-42%

This represents an overall 66% reduction in non-renewable energy consumption (after converting all units of energy into BTU's), which exceeds the 50% reduction target of the strategic goal.

Key Definitions

The following definitions are key to understanding much of this Plan. A complete Glossary is found at the back of the Plan.

Energy conservation is the practice of decreasing the quantity of energy used. It may be achieved through more efficient energy use, in which case energy use is decreased while achieving a similar outcome (e.g. improving insulation in exterior walls), or by a reduction in activities that consume energy (e.g. turning off lights when not in the room,).

Improving energy efficiency is accomplishing a task with less energy; energy efficiency may be improved by changing-out older technology equipment with newer technology equipment (for example replacing 32-watt light fluorescent bulbs with 28-watt bulbs which produce equal light).

Renewable energy is energy generated from resources that are naturally replenished—such as sunlight, wind, rain, tides and geothermal heat. While there exist differences of opinion on how best to define and classify renewable energy, the following energy technologies are usually defined as renewable: bio-mass, bio-fuels, wind power, geothermal, solar power, hydroelectricity, and waste-to-energy.

Development of the Plan

Management Services used the services of CQI Associates to assist in the research and development of the Comprehensive Energy Plan. CQI Associates is an energy and environmental management consulting firm located in Columbia, Maryland. The firm has expertise in facility operating systems, vehicle fleets and environmental and sustainability projects. Richard Anderson, Principal Consultant with CQI Associates, has worked with the Buildings and Fleet Work Groups, conducted energy assessments in eight County buildings and has analyzed fuel and vehicle use in the County's fleet.

Over the course of the past two years the work groups have developed baseline data, conducted audits, established findings from research and data, developed strategies and drafted recommendations for the Plan. Included in this Plan are specific recommendations that can reduce Frederick County Government's use of non-renewable energy by 50% over 15 years.

While there are a variety of approaches for reaching the goal of reducing non-renewable energy use by 50%, the Work Groups have attempted to reach the goal with realistic and cost-effective strategies and recommendations.

The recommendations in this Plan are divided into four sections:

- Organizational Commitment
- Buildings
- Fleet
- Utilities and Solid Waste Facilities

Baseline Data

The Buildings Work Group used calendar year (CY) 2007 for its baseline for non-renewable energy consumption in County buildings including kilowatt-hours (kWh) of electricity and therms of natural gas. During the baseline year approximately 1% of the electricity purchased was generated from renewable sources.

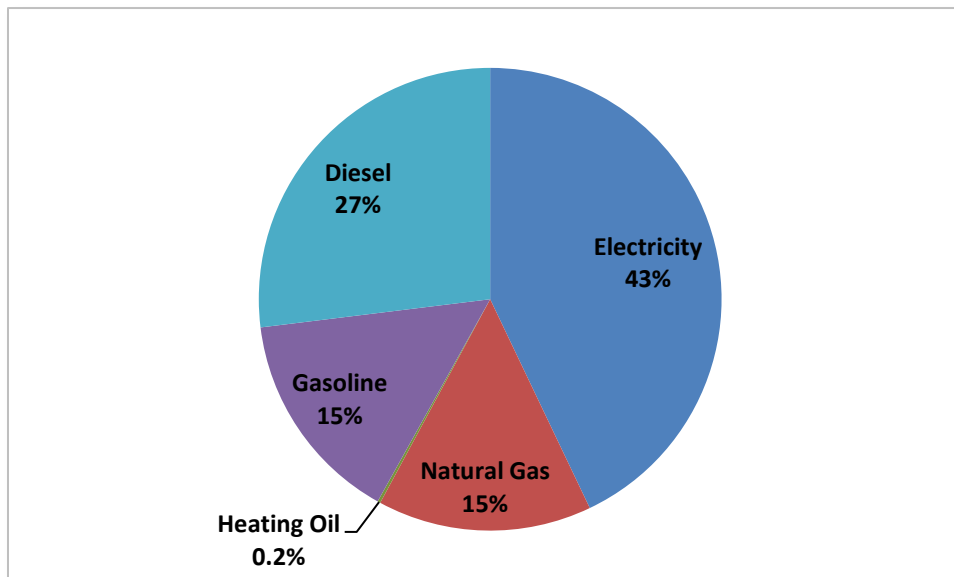
The Fleet Work Group used FY2007 data to establish a baseline for non-renewable energy consumption based on the gallons of gasoline and diesel fuel used adjusted for the 10% ethanol (renewable fuel) content of gasoline delivered in Frederick County.

DUSWM used FY2008 data for its baseline energy consumption for its water, sewer and landfill operations.

Baseline periods vary due to the availability of data and the timing of the work groups' initial analysis. The use of different baseline periods is not material to the overall Comprehensive Plan. Table 1 consists of each of the work group's baseline energy usage and Figure 1 shows the percentage each non-renewable energy source is of the County's total non-renewable energy consumption (after converting each energy unit to its Btu equivalent).

Table 1: Comprehensive Energy Plan Baseline Energy Usage

	Electricity (kWh)	Natural Gas (therms)	Gasoline (gallons)	Diesel (gallons)	Heating Oil (gallons)
Buildings (CY2007)	22,888,002	413,317			3,613
Fleet (FY2007)			433,062	615,593	
DUSWM Facilities (FY2008)	17,517,000	48,535			
Emergency Generators				7,658	
Deduct 1% generated from renewable sources	(404,050)				
Deduct 10% unleaded gals. for ethanol			(43,306)		
TOTAL BASELINE:	40,000,952	461,852	389,756	623,251	3,613
Conversion Factor to BTU	3,412.14	100,000.00	124,884.38	138,874.16	138,874.16
TOTAL BTU'S (millions):	136,488	46,185	48,674	86,554	502
COMBINED BTU'S (millions):					<u>318,403</u>

Figure 1: Frederick County's Non-Renewable Energy Usage

Site Energy vs. Source Energy

This Plan uses 'site energy' rather than 'source energy' for baseline analysis and projections of energy reduction.

'Site energy' is the energy used at the point of consumption by the ultimate customer. This is represented by the amount of heat and electricity consumed by the ultimate customer as represented on the customer's utility bills. Site energy excludes the energy used to produce and deliver energy to the ultimate customer.

'Source energy' includes all 'site energy' plus the energy used to produce and deliver energy to the ultimate customer.

Future Growth as it Relates to Meeting the Reduction Goal

For purposes of this Plan, meeting the goal is measured against the total energy consumption of buildings, fleet and DUSWM facilities operating during the baseline period. It is understood that over time additional buildings, vehicles, water/wastewater and solid waste facilities will be brought on-line to meet the needs of a growing population. This Plan does not attempt to offset future energy requirements related to this growth. However, the waste-to-energy and landfill-gas-to-energy projects currently being developed by DUSWM have the potential to provide renewable electricity sufficient for this growth. We believe the best approach for this inevitable growth is to set the stage for all new facility and fleet expansions to be highly energy efficient, meeting at a minimum all the standards that are recommended in this report for energy reductions and renewable energy use in current buildings, vehicles and DUSWM facilities.

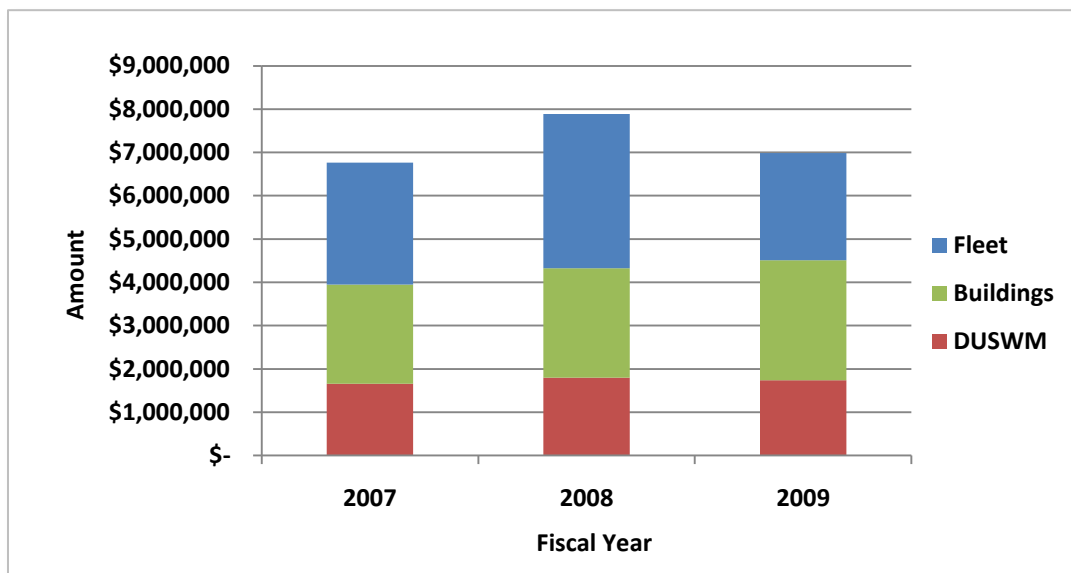
Cumulative Effect of Recommendations

With many of the recommendations in this Plan the potential reduction in non-renewable energy use is expressed as a percent reduction of the baseline usage. We acknowledge that the cumulative effect of implementing the recommendations is less than the sum of the individual percentages. This is because each recommendation that is implemented effectively adjusts the base amount of non-renewable energy for subsequent recommendations to impact. However, without knowing which recommendations will be authorized and in what sequence they will be implemented, it is impossible to calculate the cumulative percent reduction at this time except for the scenario where all recommendations are implemented.

Frederick County Energy Expenditures

To better understand the financial significance of energy use in County government, Figure 2 shows FY2007 through FY2009 costs for electricity, natural gas, fuel oil, gasoline and diesel fuel.

Figure 2: Annual Energy Expenditures



Prioritization of Implementation

This Plan presents 31 recommendations that, if fully implemented, can take the County to its goal of reducing non-renewable energy use by 50% over 15 years. The County's Sustainability Commission suggests that implementation of specific recommendations be prioritized based on the following:

- Emphasize conservation ahead of conversion whenever possible as this maximizes the reduction of overall energy use

- Emphasize recommendations with shorter payback periods over those with longer paybacks or net increases in cost
- Focus on recommendations that have proven performance records rather than banking on future technology advancements

The Commission also recommends that implementation priorities be systematically reassessed to incorporate technology advances and changes in financial viability of recommendations.

RECOMMENDATIONS

1.0 ORGANIZATIONAL COMMITMENT

Background

The Organizational Commitment recommendations relate to the roles of elected officials, top managers and all County employees in the success of this Plan. The outcomes of these recommendations do not identify reduction strategies directly related to vehicles, buildings or DUSWM facilities. However, they do play an important role in maintaining a high degree of commitment and determination to reach the energy reduction goal of the County Commissioner's Strategic Plan.

The County has been promoting and supporting energy conservation in a number of ways including an active Energy Conservation Committee, the use of EnergyDog as the mascot for conservation efforts in regular memos to employees, green building designs for the Brunswick and Walkersville libraries and Catoclin Nature Center, and the creation of the Office of Environmental Sustainability and citizen Sustainability Commission.

Energy Conservation Committee

The County's Energy Conservation Committee is comprised of a cross-section of County employees and meets bi-monthly to discuss current conservation and energy efficiency initiatives, learn about new conservation technologies, and share future plans for energy conservation. The committee reviews and encourages conservation initiatives throughout the County. Since the committee was formed in 2005, it has made annual presentations to the County Commissioners on conservation efforts which now provide ongoing operating savings of \$150,000 annually.

EnergyDog

EnergyDog is the Energy Conservation Committee mascot, created to bring a light-hearted and identifiable image for conservation awareness to County employees. EnergyDog is a typical yellow Labrador retriever, with a love of people, a good nose for sniffing out trouble, and a steady determination to get the job done. His main job is to engage employees in energy conservation in the workplace. Occasionally, he will provide tips that work at home as well. EnergyDog's slogan is..."Don't be a hog, be an Energy Watchdog!" Since EnergyDog was first introduced to employees, he has provided over 30 energy conservation ideas to employees.

Office of Environmental Sustainability

The Board of County Commissioners established the Office of Environmental Sustainability (OES) effective January 2009. Since that time the office has been moving forward with sustainable practices, policies and partnerships in County government.

OES has applied for several grants and been awarded the Department of Energy's 2009 Energy Efficiency and Conservation Block Grant (EECBG) that will expand the capabilities of the Sustainability Office and the County to support conservation, renewable energy and green building policies and programs both for County government and the County as a whole.

OES is working in conjunction with the ongoing energy conservation efforts of County divisions and is serving as a focal point for communication between County energy-related efforts and the community at-large. A citizen-based Sustainability Commission was appointed by the County Commissioners in April 2009 and an employee Sustainable Action Team was formed in August 2009.

ORGANIZATIONAL COMMITMENT RECOMMENDATIONS

In the following section recommendations are presented that will establish and support the County's prioritization of the energy reduction strategic goal.

Organizational Commitment Recommendation 1.1: Obtain and demonstrate support and commitment from the County Commissioners and all management levels for energy conservation and the energy reduction goal in the County Commissioner's Strategic Plan.

A successful comprehensive energy plan will require commitment from elected officials and all levels of County management. The County Commissioners, County Manager's Office and Division Directors need to regularly articulate to employees their commitment to energy efficiency and conservation. This entails energy awareness, best practices, coaching and action. Effective leadership will help to motivate employees to effect change throughout the organization. The established goals must be communicated clearly to achieve the energy reduction target.

Top-level management must also lead by example. Managers should be the first to incorporate energy reducing measures in their own offices, facilities and use of vehicles. Employees should see a clear connection with energy conservation in the decisions their managers make. To demonstrate their commitment to energy conservation managers should make energy conservation a part of meeting agendas, one-on-one discussions with employees and annual performance appraisals.

The County Commissioners have already taken several significant steps in demonstrating support and leadership for the energy reduction goals in their Strategic Plan:

1. Established the Office of Environmental Sustainability to coordinate County-wide sustainability efforts including energy conservation.
2. Authorized creation of a citizen Sustainability Commission.
3. Approved the design of 2 branch libraries to LEED 'Certified' standards.
4. Endorsed the "U.S. Mayors Climate Protection Agreement" which supports actions to reduce global warming pollution, including energy conservation and conversion to cleaner renewable energy sources.

Reduction in non-renewable energy: There is no empirical data on which to definitively project energy savings from this recommendation. However, it is the belief of the drafters of this Plan that consistent and meaningful support from leaders and managers within County government could easily generate energy savings in our buildings and fleet of at least 1 percent by keeping the goal of this Plan in a position of prominence and high priority.

Investment: No monetary investment is required.

(Lead Agency = Office of Environmental Sustainability)

Organizational Commitment Recommendation 1.2: Conduct staff education on the importance of energy conservation to the goals of County government and on techniques for conserving energy in the workplace.

Every employee contributes to the use of energy in the workplace. Active employee participation in energy conservation is essential to achieving maximum energy savings and reaching the 50% reduction of non-renewable energy use.

Employee buy-in and participation in energy conservation is integral to the County's overall success in making serious reductions in consumption of non-renewable resources. In order for institutional change to occur a broad staff education program is needed which should include:

- New employee training on County energy goals
- Regular staff training on energy conservation
- Readily available educational materials for managers and employees

Information should be provided on:

- Ways the County is reducing its energy consumption
- Introduction to the Comprehensive Energy Plan
- How to reduce energy consumption in the work place
- The impact of employee involvement in energy reduction and the potential savings to the County
- What other counties and employers are doing to reduce energy consumption
- Green purchasing, procurement and products and their impact to energy
- Energy conservation at home
- Fuel conservation for fleet vehicles
- Feedback on County conservation and renewable energy initiatives

There are many ways that education can be provided to employees¹:

- Pamphlets and flyers
- Posters in lunch rooms and on bulletin boards
- Special events and County participation in nationally recognized 'conservation' days
- Building competitions and recognitions
- County intranet
- County newsletter
- Friendly reminders when employees leave their lights or computers on at night
- Promotion of carpooling and Rideshare opportunities
- Continuation of monthly EnergyDog tips

¹ Reference: <http://psgreenfleets.org/reduction-strategies/reduce-fuel-use>

- Outreach from the Sustainable Action Teams of the Office of Environmental Sustainability

Reduction in non-renewable energy: Education can affect behavior. To the extent people understand how their actions result in energy consumption, there are opportunities to increase conservation efforts. While there is no empirical data on which to project energy savings from this recommendation, the drafters of this Plan believe that energy consumption in the buildings and fleet could be curtailed by 1% on the basis of informed employees making improved energy use decisions.

Investment: The investment would be minimal to provide all of the education anticipated by this recommendation.

(Lead agency = Office of Environmental Sustainability)

Organizational Commitment Recommendation 1.3: Adopt written energy conservation expectations for County employees.

Written energy conservation expectations for employees adopted by the County Commissioners will provide important support for the goals of this Comprehensive Energy Plan by:

- Demonstrating leadership from the County Commissioners to energy conservation
- Reinforcing the County Commissioner's Strategic Goal and the recommendations set forth in this Plan
- Increasing employee awareness of the importance of energy conservation in the workplace
- Unifying employees in energy conservation efforts
- Demonstrating to the community that Frederick County employees are responsible energy and environmental leaders

Employees need to be aware of their contribution to the County's energy usage, participate in conservation efforts, and understand their role in the County Commissioner's strategic energy reduction goal.

Informed employees are more likely to contribute ideas, operate equipment properly and follow procedures.² It is difficult to expect employees to change their daily energy habits without providing the materials and guidance they need to change their perspectives and practices. Establishing written expectations will provide employees with clear direction regarding acceptable energy conservation practices.

Written energy conservation expectations would address the following:

- Understanding the County Commissioner's goal to reduce non-renewable energy consumption
- Exercising sound energy efficiency and conservation practices in the use of buildings
- Exercising sound conservation practices in the use of vehicles and equipment
- Continual learning about energy conservation in the workplace.
- Supporting initiatives promoted by all Divisions
- Being open to new and creative ways of conserving energy

It is possible that employee energy conservation expectations could be combined with broader sustainability expectations that may be developed by the Office of Environmental Sustainability and the employee Sustainable Action Team.

² Reference: "Teaming Up to Save Energy – Protect our Environment through Energy Efficiency" an ENERGY STAR pamphlet.

Reduction in non-renewable energy: This recommendation will support the outcomes of Recommendations 1.1 and 1.2. No additional reduction is projected.

Investment: Establishing and promoting written energy conservation responsibility expectations for County employees could be done with minimal expense.

(Lead Agency = Office of Environmental Sustainability)

Organizational Commitment Recommendation 1.4: Provide an annual report on the progress of the Comprehensive Energy Plan recommendations.

An annual report will be a high profile public document presenting the progress of the County in meeting the County Commissioner's strategic energy-reduction goal. This 'annual' report card on the County government's efforts should provide additional motivation for ensuring the Plan's success.

The annual report will provide an assessment of the Plan's implementation of both energy conservation and the conversion to renewable energy. The report would include a recap of the following:

- Initiatives implemented
- New policies and procedures
- Energy reduction
- Investment in conservation and renewable energy projects
- Operational savings
- New technologies utilized
- Renewable energy projects
- Educational trainings
- Results of future energy audits for buildings or the vehicle fleet
- Modifications to target reductions or recommendations in the Plan

Reduction in non-renewable energy: The annual report will be an important component of the Plan; however specific energy reductions are not linked with this recommendation. The recommendation will help to keep the County on track and accountable to the County Commissioners, employees and citizens.

Investment: This recommendation will require up to 80 hours of staff time per year but financial investment would be minimal as the report would likely be published online, rather than in hard copy.

(Lead Agency = Management Services Division)

2.0 BUILDINGS

Background

Buildings Work Group

The Buildings Work Group includes employees from Management Services and Maintenance. Within this work group is experience and expertise in all aspects of building operation, renovation, construction, maintenance and related technologies.

This group analyzed energy use in County buildings and developed strategies for reducing non-renewable energy used in County buildings, parks and street and traffic lights.

Baseline Energy Use

The Buildings Work Group selected CY2007 as the baseline year for energy consumption. During CY2007 there were a total of 107 'energy consuming sites' including County buildings, parks, street and traffic lights that generated natural gas and/or electricity billing accounts. County buildings range in size from 448 square feet to 194,189 square feet and total 1,218,476 square feet for the baseline year.

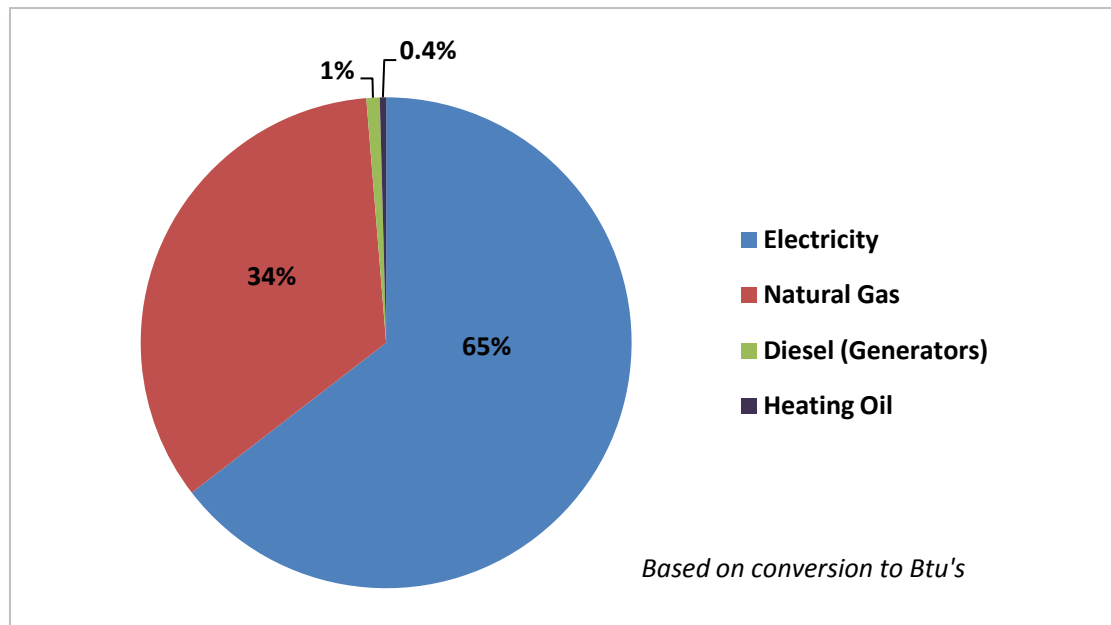
Total electricity consumption during the baseline year was 22,888,002 kilowatt-hours (kWh). Based on standard customer information from the County's electricity supplier approximately 1% of the total electricity purchased by the County was produced from renewable sources during the baseline year.

Total natural gas consumption in the baseline year was 413,317 therms.

The County has four buildings that use heating oil. For the baseline year 3,613 gallons of heating oil were used.

There are eleven buildings with emergency generators. The generators used 7,658 gallons of diesel fuel during the baseline year.

Included in Figure 3 is the percentage of each non-renewable energy source consumed during the baseline year of CY2007.

Figure 3: Calendar Year 2007 Baseline Energy Consumption

Target Energy Reduction

Although the County Commissioner's Strategic Goal does not require that each segment of energy use (buildings, fleet and DUSWM) reduce non-renewable energy consumption by 50%, only that the total reduction for the County be 50%, the Building Group adopted a 50% reduction as its target.

Current Conservation Practices

The County has been actively involved in energy conservation in County buildings for many years. Some of the more significant conservation practices are listed below:

Preventive maintenance and building inspections

Both preventive maintenance (PM) and building inspections are conducted on a routine basis for every County building. PM is designed to preserve and enhance equipment reliability through regular inspection of equipment and routine replacement of worn components. This helps to ensure energy-consuming equipment consistently operates efficiently and effectively, using the least amount of energy possible. Preventive maintenance includes:

- Changing of filters and belts
- Checking of returns and exhaust grills
- Cleaning evaporator and condenser coils
- Checking economizer operation
- Lubrication of bearings and water pumps

- Refrigerant charges
- Inspection of compressors and motors
- Inspection of electrical and plumbing systems for proper operation

Routine building inspections ensure:

- Equipment and lighting is operating efficiently
- The building envelope, including roof, windows, walls and doors are in sound condition
- Building occupants are practicing conservation in use of lighting, computer, appliances and other electrical devices.

Standard heating and cooling temperatures

The 1991 the County Commissioners adopted a “Temperatures in County Buildings” policy establishing 68 degrees for heating and 74 degrees for cooling as standard temperature settings for County buildings. The policy also prohibits the use of space heaters of any type because these heaters are high energy consumers and potential safety hazards.

Upgrades to lighting

In the early 1990's the County replaced most T-12 40-watt fluorescent lighting fixtures with more efficient T-8 32-watt fixtures with electronic ballasts. Over the course of fiscal years 2008 and 2009, Maintenance personnel have replaced all of the remaining T-12 40-watt fluorescent lights with T-8 32-watt fixtures. For each 4-bulb fixture that is on 9 hours each workday, this change results in a savings of \$7.50 per year in electricity costs. In 2009 Maintenance began the use of 28-watt fluorescent bulbs as the standard when replacing fluorescent bulbs. This holds the potential for an additional 7-8% reduction in building lighting costs. Exit lights are being replaced with LED fixtures as replacement is necessary.

Occupancy sensors

In 2005 Maintenance began installing occupancy sensors in bathrooms at the LEC as a pilot project. By the end of FY2007 Maintenance personnel had installed occupancy sensors in all bathrooms throughout County-owned buildings.

As part of the MEA EmPOWER Clean Energy Grant Program additional occupancy sensors will be installed in other areas of buildings where additional energy savings can be obtained.

Night setbacks

Through 2005 and 2006 Maintenance programmed thermostats in 13 buildings with night setback settings. These settings adjust building temperature by 3 to 4 degrees from the normal occupied building setting. Energy savings are typically two percent of space heating or cooling energy per degree of temperature setback.

Energy Management Control Systems (EMCS)

An EMCS is a customized control system that controls many pieces of equipment from one location, either on-site or remotely. The Maintenance Department currently utilizes EMCS for 10 County-owned buildings primarily for HVAC control. The systems improve the energy usage for the buildings by programming night setbacks and other building equipment. In addition to energy savings EMCS allows for proper monitoring of temperature, humidity, and other building equipment and eliminates unnecessary services calls and cuts back on overhead expenses.

CQI Associates Building Energy Audits

In 2008 CQI Associates conducted energy audits of eight County buildings to provide energy saving recommendations and to assist in the development of this Plan. CQI's complete "Energy Management Assessment Study", dated April 8, 2009, for these eight buildings is included in Appendix A.

Buildings that were audited include:

- Citizens Services
- Courthouse Complex
- DPW Building
- Health Department
- Law Enforcement Center
- Transit
- Urbana Library and Senior Center
- Westview Fire Station

CQI Associates provided both short-term and long-term recommendations to improve the energy efficiency of the buildings and assist in meeting the overall goal of the Plan.

With these energy audits completed, the County was successful in obtaining an \$80,000 grant from the Maryland Energy Administration's EmPOWER Clean Energy Grants Program to implement some of the recommendations in the audits.

BUILDING RECOMMENDATIONS

In the following section recommendations are presented for reducing the use of non-renewable energy in County buildings. The recommendations are based on the work of the Buildings Work Group, input from CQI Associates and the findings in the initial 8 energy audits completed by CQI Associates.

The overall analyses suggest that strategies based on the following main areas will meet the energy reduction goal:

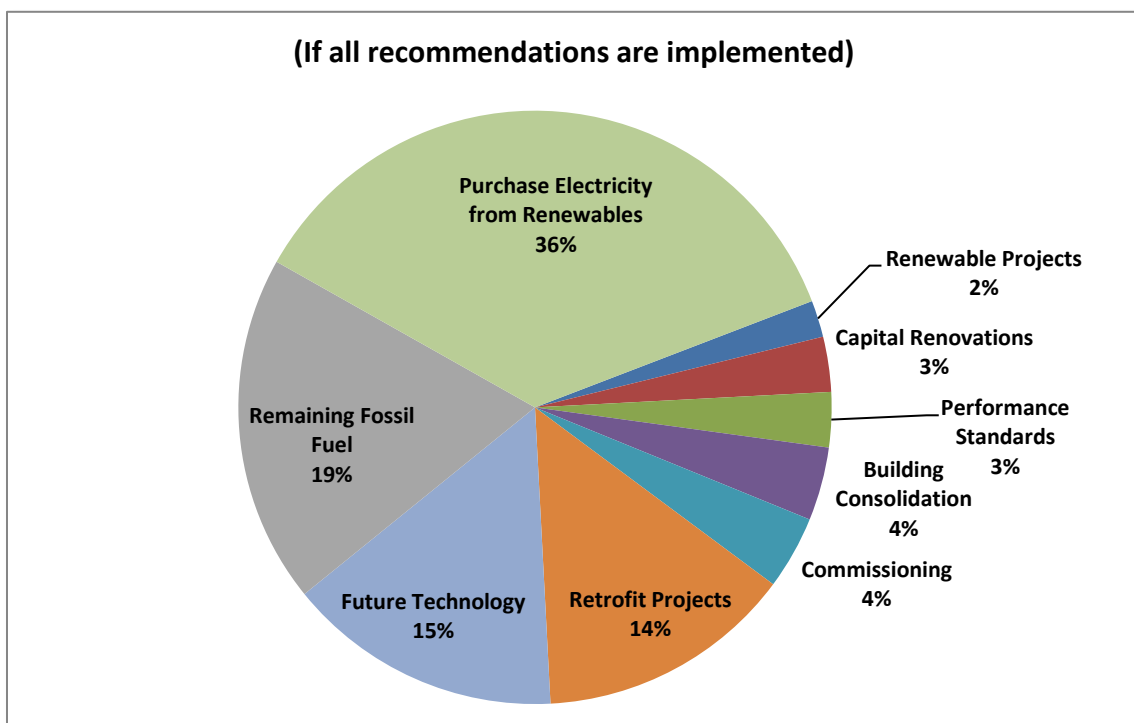
- The application of high efficiency energy performance standards for new construction and renovation projects and the retrofitting of existing building heating, cooling ventilation, lighting and control systems will improve efficiency and reduce the consumption of fossil fuels by up to 21%.
- On-site renewable energy installations utilizing geo-thermal, solar or wind energy could contribute up to a 4% conversion to renewable energy.

- Purchase of electricity with an increased percentage of renewable generation sources from the County's electricity vendor could achieve up to an overall 10% conversion to renewable energy.
- Future technology advances that are currently in research and development are projected to achieve up to a 20% conversion to renewable energy by 2024.
- Building consolidation of down-town office building locations could provide up to a 5% reduction of fossil fuels.
- Commissioning of existing County occupied buildings could result in up to a 5% energy reduction.
- Capital renovations such as HVAC upgrades and roof replacements could attain up to a 4% reduction in non-renewable energy.

Cumulative Effect

Figure 4 is the breakdown of each main strategy and the cumulative effect on reaching the reduction goal.

Figure 4: Non-Renewable Energy Reduction of Building-Related Energy Usage by 2024



If all of the Buildings Work Group recommendations are implemented the cumulative effect will be a reduction of 81% in building-related consumption of non-renewable energy. Approximately 50% of the reduction would be achieved through conservation and 50% through conversion to renewable energy sources by 2024.

Buildings Recommendation 2.1: *Adopt an Energy Management Program based on uniform operations, maintenance, and design standards.*

To make certain that County buildings are operating as efficiently as possible the County should implement an energy management program to standardize building system specifications and operating practices. A proposed Energy Management Program is included in Appendix B and covers design and operating specifications for:

- HVAC mechanical equipment
- Boiler systems
- Building automation systems
- Occupied temperature settings and controls
- Non-occupied cycle and night setback settings and controls
- Special use HVAC applications
- Lighting
- Lighting – foot-candle levels
- Exterior lighting
- Exit fixtures
- Lighting controls
- Domestic hot water systems
- Demand monitoring and reduction
- Appliances
- Air compressors
- Water
- Unit heaters
- Exhaust systems
- Humidity systems
- Building envelope (roof, walls, windows and doors)
- Vending machines

Existing buildings should be routinely evaluated against the specifications to ensure optimum energy efficiencies. These standards should also be reviewed and addressed with every renovation, new construction and major equipment replacement. Each project should meet the requirements of the Energy Management Plan to ensure that the most energy efficient equipment for the intended purpose is installed and operated to the Plan's standards.

Reduction in non-renewable energy: Reductions in energy use will vary from building to building and project to project. Routine application of the principles recommended in the proposed Energy Management Program could be expected to reduce overall energy consumption in County buildings by at least 1%. A 1% reduction would be equivalent to 226,000 kWh of electricity and 4,000 therms of natural gas annually.

Investment: There will be no monetary investment for standardizing operational procedures, only staff time.

(Lead Agency = Management Services Division)

Buildings Recommendation 2.2: Conduct energy audits of all major County buildings.

A building energy audit provides an assessment of a building's operating systems and structure and their impact on energy consumption. In 2008 eight occupied County buildings were audited by CQI Associates using a standard planning grade energy assessment process. The resulting "Energy Management Assessment Study" (Appendix A) identifies programs and projects to reduce energy consumption and costs. The report provided both short- and long-range energy conservation recommendations which are defined as follows:

- Short-term projects to be completed within 1-2 years.
- Long-term projects to be completed within 3-5 years.

Based on the results of the 8 energy audits already completed, significant energy reductions can be realized through improved equipment operation and maintenance practices, improved energy controls, and retrofit and replacement projects.

The County has 29 other major buildings that would benefit from energy audits. The energy audit reports will guide staff in making energy conservation and efficiency improvements on both a long- and short-range basis.

Note: Having some energy audits already completed positioned the County to apply for and ultimately be awarded an \$80,000 grant from the Maryland Energy Administration – EmPOWER Clean Energy Grants Program to implement many of the recommendations in the initial CQI energy audits.

Reduction in non-renewable energy: Although this recommendation does not, in and of itself, reduce energy usage it does set the stage for energy-saving projects included in Recommendation 2.3.

Investment: The estimated cost to perform 29 building energy audits is \$67,250. Twenty-one energy audits are already grant funded; four through the EmPOWER Clean Energy Grants Program and 17 through the EECBG program.

(Lead Agency = Management Services Division)

Building Recommendation 2.3: Make steady advances in energy conservation and energy efficiency in County buildings by implementing recommendations from building energy audits.

The energy audits conducted by CQI Associates in 2008 identified programs and projects to reduce energy consumption in eight County buildings. The cost estimate for CQI's recommended efficiency improvements is \$1,034,850 which includes \$177,450 for short-term projects and \$857,400 for key long-term projects. These energy audits provide an effective mean to target energy saving projects. Additional building energy assessments are recommended in Recommendation 2.2.

The findings and recommendations from these audits provide a sense of the ongoing investment needed to bring the County's buildings to an increased level of energy efficiency. Steady investment will bring steady increases to energy reduction and savings.

Having a line item for 'Energy Conservation Improvements' in the Maintenance Department budget or in the CIP would demonstrate a long-term commitment by the County Commissioners to energy conservation and establish the expectation that continual improvements are to be the norm.

Because of increasing government interest in energy conservation, grant opportunities for energy related projects are anticipated over the 15-year life of the Plan. As a part of a grant application process applicants are frequently asked to demonstrate a continuing commitment to the goals of the grant. Having County funds already committed to achieving energy conservation and efficiency will generally improve the County's ranking in the grant review and approval process.

As operational savings accumulate from energy conservation projects, those savings can serve as an ongoing source of funds for additional energy conservation and efficiency projects. Since the Energy Conservation Committee was formed in 2005, there have been a series of projects that provide on-going savings of over \$150,000 annually.

Reduction in non-renewable energy: Based on the first 8 building assessments, the annual reduction in non-renewable energy use for the remaining 29 buildings is projected to be 2,460,000 kWh of electricity and 30,500 therms of natural gas by the year 2024.

Investment: Based on the costs of the energy conservation projects identified for the 8 buildings assessed by CQI, the cost for conservation improvements to the remaining 29 buildings (short of complete system replacements and major renovations) is projected to be \$250,000 per year for the 15-year life of the Plan.

(Lead Agency = Management Services Division)

Buildings Recommendation 2.4: Install a centralized Energy Management Control System for County buildings.

A centralized Energy Management Control System (EMCS) is a customized computer-based system that monitors and controls building systems for multiple buildings from a single location. The Maintenance Department currently utilizes individual EMCS in 10 County-owned buildings.

Systems can be designed for the level functionality and capability required for each building and can control:

- HVAC
- Lighting
- Exhaust fans
- Thermostat controls (temperature setbacks)
- Water heaters
- Fire and life safety
- Security systems
- Elevators

The proposed centralized EMCS would have controls in each major occupied building with central monitoring available at the County's Maintenance Department. Inaugurating a multi-site monitoring and control system would provide a number of benefits:

- Facilitate the management and reduction of energy usage in the County buildings through consistent system-wide application of energy use protocols
- Monitor energy consumption and reduce the cost per square foot related to heating and cooling costs
- Allow for automatic and consistent reaction to building system 'events'
- Allow staff to quickly gather and view information needed to evaluate a building's status
- Permits off-site diagnosis of reported problems, reducing the number of service calls and overhead expenses during overtime hours (i.e. evenings and weekends)

Reduction in non-renewable energy: Reductions in energy usage will vary depending on a building's present energy efficiency and the proposed EMCS. Assuming that HVAC and lighting are controlled in each building by a centralized EMCS this recommendation could result in a 4% reduction in overall building-related energy consumption.

Investment: Installation of a centralized EMCS for HVAC and lighting in all existing occupied buildings is estimated to cost \$1,500,000.

(Lead Agency = Management Services Division)

Buildings Recommendation 2.5: Continue to use EPA's ENERGY STAR Portfolio Manager software to analyze energy consumption, costs, and performance in County facilities to identify and prioritize energy conservation and efficiency projects.

Portfolio Manager is an interactive energy management software application that allows users to track and assess energy and water consumption for an entire portfolio of buildings. Portfolio Manager accounts for building construction, occupancy, and type of use and normalizes energy consumption data for variations in outdoor temperature. The program then ranks a building's energy efficiency based on a comparison with buildings of a similar size and use. The Portfolio Manager rating is expressed as a *percentile ranking* indicating what percent of similar buildings are less efficient. For example, a Portfolio Manager ranking of 65 indicates 65 percent of similar buildings are less energy efficient. Or to put it another way, the building is in the top 35 percent of similar buildings when ranked for energy efficiency.

The Maintenance Department signed on as a user of the ENERGY STAR Portfolio Manager program in 2008. Data on County buildings has been entered from electricity, natural gas, and water bills for 2007 through 2010 to-date.

Portfolio Manager is useful in determining which buildings are operating most efficiently and which buildings need additional attention. The ranking can assist in prioritizing improvement projects. The Health Department Building has achieved the ranking required for the ENERGY STAR Building Certification, which is earned when a building's energy efficiency is at or above the 75th percentile of similar buildings when ranked for energy efficiency.

Not all buildings are currently rated in Portfolio Manager because the EPA has not yet established normalized ranking criteria for all types of buildings owned by the County (for example, libraries and fire stations). County buildings that have been rated in Portfolio Manager are listed in Appendix C.

Reduction in non-renewable energy: While this recommendation will not directly provide a reduction in non-renewable energy, the use of Portfolio Manager will help in identifying and prioritizing buildings that will benefit from energy conservation and efficiency improvements.

Investment: Using Portfolio Manager has no direct cost except for the staff time to input and review utility consumption data which is estimated to be 80 hours per year.

(Lead Agency = Management Services Division)

Buildings Recommendation 2.6: Continue the County's capital program of building renovations that include HVAC system upgrades to improve performance and energy efficiency.

In the late 1990's the County's Maintenance department developed a long-term program to renovate County buildings primarily geared towards replacement of aging mechanical and electrical systems. The scope of each project is specific to the building but renovation work extends to some or all of the following building components:

- HVAC mechanical equipment
- HVAC ductwork
- HVAC controls
- Floor plan changes
- Flooring and ceiling replacement
- Fire alarm system
- Sprinkler system
- Hazardous material abatement
- ADA upgrades
- Roof replacement

Redesign and replacement of aging or poorly-designed HVAC systems and controls can greatly improve energy efficiency for a building. Appendix D shows each of the projects in the County's "HVAC-Related Renovations" program. Three of the projects are basic HVAC unit and control replacement projects. The balance of the projects includes renovations and upgrades to a broad range of building systems. The total cost of the building renovation program is approximately \$23 million with the program approximately 50 percent complete as of September 2009. While it is difficult to separate the HVAC renovation/replacement costs from other renovation costs in the projects, we do know that such projects improve the energy efficiency of County buildings. Below in Table 2 shows the changes in the ENERGY STAR Portfolio Manager rankings for 3 buildings that underwent HVAC renovations:

Table 2: County Building ENERGY STAR Portfolio Manager Rankings

Building	Before Renovation	After Renovation
Head Start Building (Sagner Ave.)**	1	32
DPW	45	71
Winchester Hall	27	37

** Portfolio Manager does not have a ranking scale for a building with the mixed office/classroom use of the Head Start building. However, the difference in the ranking is indicative of the significant improvement in energy efficiency attributed to this renovation project.

Reduction in non-renewable energy: The remaining programmed HVAC improvement projects are expected to reduce energy consumption by 1,200,000 kWh's of electricity and 10,000 therms of natural gas annually.

Investment: The remaining 8 building renovation projects that include major HVAC replacements and/or upgrades are projected to cost \$10.5 million of which approximately \$5.5 million relates directly to HVAC. However, these 8 projects are necessitated by equipment reaching the end of their useful lives and the investment is required regardless of energy conservation.

(Lead Agency = Management Services Division)

Buildings Recommendation 2.7: *Adopt high performance energy efficiency standards for new County buildings and major renovation projects starting in FY 2011.*

Establishing building standards for energy consumption would position the County to design and construct buildings that maximize energy efficiency. A design standard could be an existing nationally recognized design standard or a custom design standard developed for Frederick County Government projects.

County buildings currently account for 38% of the County's total energy consumption. When a new building project is started there are many stakeholders in the design and construction process. At the present time there are no adopted standards for County buildings regarding energy efficiency other than what is found in general building codes and/or industry standards. Nor is there a single operating Division that can dictate such standards. This recommendation proposes that the BOCC adopt standards for energy efficiency and building performance that would become a part of the design criteria for all future County buildings and major renovations.

An Existing Accepted Energy Efficiency Standard:

U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Certification Program is an internationally accepted rating system that emphasizes high performance and low environmental impact in the design, construction and operation of buildings. LEED promotes a whole building approach to sustainability by recognizing performance in five key areas of human and environmental health:

- Sustainable site development
- Water savings
- Energy efficiency
- Materials selection
- Indoor air quality

Designing to LEED standards not only makes a positive impact on public health and the environment, it also reduces operating costs, enhances building and organizational marketability, potentially increases occupant productivity, and contributes to a sustainable community. LEED standards strike a balance between established practices and emerging concepts.

A Customized Energy Efficiency Standard:

The use of a customized energy efficiency standard has several advantages:

- Emphasize factors of specific interest to the County Commissioners (for example: the use of renewable energy on- or off-site, vegetated roofs, etc.)
- Eliminate cost of validation required by LEED standards
- Achieve employee buy-in through a participative standard development process

A disadvantage to using a customized standard would be the lack of existing benchmarks to rate the overall impact of applying the standard.

Note: The Energy Efficiency and Conservation Block Grant (EECBG) application submitted to the U.S. Department of Energy in June of 2009 included a proposal for developing a green building program specifically for Frederick County that would include high performance energy efficiency standards for both public and private sector buildings.

Reduction in non-renewable energy: Energy savings from high efficiency designs can be as high as 40% from conventional designs. This will be especially important for new building construction. For purposes of reducing our baseline energy use (i.e. existing buildings), the incremental savings of high efficiency replacements over standard replacements for the buildings expected to be renovated over the 15 year life of this Plan should provide an overall energy reduction of 2%.

Investment: High efficiency buildings generally have higher design and construction costs but lower operating costs than conventional buildings. While costs are unique to each project, there is some consensus that design and construction costs for new buildings are increased by 2-5%. We estimate that renovation projects costs would be increased by 20% to cover high efficiency HVAC and lighting. For the 8 buildings programmed for renovation over the next 15 years the incremental cost for high efficiency is estimated at \$1,000,000.

(Lead Agency = Office of Environmental Sustainability)

Buildings Recommendation 2.8: *Use on-site renewable energy for County buildings when technically and financially feasible.*

On-site renewable energy technology is a fast-growing industry around the world. The most common on-site renewable energy sources used for buildings are:

- Passive solar – using sunlight to heat water for domestic water use or for space heating
- Photovoltaic – converting the energy in sunlight into electricity
- Geo-thermal – extracting or rejecting heat below the surface of the earth
- Wind – using the energy of wind to generate electricity

Each of these renewable sources comes with its own set of practical limitations, property and location requirements, and investment requirements. However, each is actively used in many parts of the world and can readily be designed in new buildings or major renovation projects. Local examples of successful onsite renewable projects include the geothermal heating and cooling dormitory at Mount Saint Mary's University in 2008; along with the solar power (photovoltaic) farm currently under construction and estimated to be completed in 2012.

Not every County building site is readily adaptable to on-site renewable energy production based on current technologies. However, over the next 15 years, it is certainly possible that one or two sites could be adapted for some significant level of on-site renewable energy production.

Reduction in non-renewable energy: The application of existing renewable energy technologies to existing buildings has the potential to convert up to 4% of the energy consumption in County buildings to a renewable source.

Investment: The cost for utilizing on-site renewable energy sources will vary greatly depending location and type of renewal energy used. A portion of the additional initial investment will be offset by the lower ongoing annual operating costs. At this time, we cannot project a cost.

(Lead Agency = Management Services Division)

Buildings Recommendation 2.9: Purchase either renewable energy certificates or direct purchase electricity generated from renewable sources for 15% of the County's electricity requirement starting in 2013. Purchase additional renewable electricity when the waste-to-energy facility comes online.

One strategy for reducing the use of non-renewable energy is to increase the use of renewable energy sources. The County has four options for acquiring electricity generated from a renewable energy source:

1. Purchase electricity with a mix of renewable generation sources from a traditional electricity provider. Over the past few years, information from the County's electricity provider indicates that approximately 1% of the electricity supplied to the County is generated utilizing renewable energy sources. For some additional cost, most wholesale electricity providers will sell electricity that has up to a 15% mix of renewable sources. This option, though available now from some suppliers, is expected to become more readily available and competitive over the next 3-5 years. The County's current contract for electricity expires in November 2013.
2. Purchase renewable energy certificates (REC's) to ' earmark' a certain portion of electricity produced elsewhere by a renewable energy source as consumed by the County. Renewable energy certificates represent the environmental attributes of electricity produced from renewable energy projects and are sold separately from the power commodity. A certifying agency gives each REC a unique identification number to ensure it is not double-counted. The 'green' energy is then fed into the electrical grid, and the accompanying REC can then be sold by the producer on the open market.

Purchasing REC's could be done without waiting for the next electricity contract in November 2013.

3. Purchase renewable electricity generated from the planned waste-to-energy facility scheduled to open in 2015. While REC's may not be available, as a partner in this project, Frederick County will be able to directly purchase electricity generated by this facility. The opening of the facility will not occur before 2015. It is projected that the cost of electricity produced by the facility will be competitive with other renewable sources of power. (More information on the WTE project is found under Recommendation 4.2 in this CEP.)
4. Purchase renewable power through power purchase agreements (PPAs). A PPA is a financial arrangement in which a third-party developer owns, operates, and maintains the renewable system. A host customer (the County) agrees to site the system on their roof or other location on their property, and purchase the system's

electric output from the service provider for a predetermined period (term length can be from 6 to 25 years).

There are several benefits for the County to use PPAs. First, there is no upfront capital cost to the County for the installation of the project. Secondly, the electric output that is generated from the system can be predicted and the County would know how much the energy would cost. Third, there is no system performance or operating risk, and finally the project can be cash flow positive from day one.

One major important benefit is the visibility of demonstrating the County's environmental commitment to reducing non-renewable energy.

Reduction in non-renewable energy: This recommendation would increase the amount of electricity generated from renewable sources purchased by the County from 1% to 15%. This will result in an additional 5,600,000 kWh's of electricity acquired from renewable sources. When the waste-to-energy facility comes on-line the County will be able to purchase all of its electricity requirements from the facility.

Investment: The cost *premium* for either the purchase of REC's equal to 15% of the County's electricity requirement or the direct purchase of electricity from renewable sources for 15% of the County's electricity requirement is estimated to be \$80,000 per year. If this same premium level exists for electricity purchased from the WTE operation, the County would pay a premium of \$534,000 annually to purchase 100% of its building-related electricity requirement as renewable power.

(Lead Agency = Management Services Division)

Buildings Recommendation 2.10: Implement the “Technology Energy Management Plan” Developed by the Interagency Information Technology Division.

In April 2008, IIT developed a Technology Energy Management Plan (Appendix E) which included new technologies to reduce energy consumption related to communication and data technologies and ensure adequate power is available to meet future IIT needs. Outlined in the Technology Energy Management Plan are six areas of energy conservation and efficiency improvements that IIT has either recently initiated or has plans to implement.

1. Smart Clients or virtual desktop infrastructure (VDI). Smart Clients “reduce power consumption by implementing Smart Client technology for low to mid level users”. Smart Clients reduce energy use by eliminating the need for local hard drives, external hardware ports and floppy drives. A traditional desktop computer uses \$35.00 of electricity a year compared to an estimated \$6.00 a year for a Smart Client. The County has approximately 2,000 desktops and IIT estimates that 70 to 80% could be converted. If 10% of the desktops were converted each year it would provide a savings of \$5,800 and an estimated 58,000 kWh of electricity annually.
2. IIT uses server virtualization to host multiple server operating systems on one physical server, versus one operating system per physical server, thus reducing the need for dedicated physical platforms for each server. Currently IIT has 90 virtual servers residing on 19 virtual hosts which provide a savings of \$79,000 and an estimated 790,000 kWh of electricity annually.
3. In addition to server virtualization IIT has installed 35 “green” servers which utilize energy smart power supplies in the server line. These 35 servers provide a savings of \$13,000 and an estimated 130,000 kWh of energy annually.
4. IPSAN is technology that allows IIT to stand up a large amount of physical disk space in its own environment, which can be allocated to servers throughout the network. This decreases the number of disk drives in a server thus decreasing the server’s energy footprint. Implementation of the IPSAN has saved the need for 120 additional dedicated server hard drives, resulting in a savings of \$840 per year and 8,400 kWh.
5. Over the past 2 years IIT and Management Services have installed approximately 80 multifunctional printers (MFDs) throughout County buildings and removed over 200 network and local printers reducing the power requirements for printing and copying.
6. In another area of its operations, IIT is planning renovations to the main data center in Winchester Hall to increase energy efficiency. In-line rack air conditioning will be

installed which will target server and network equipment for cooling eliminating the need to apply intensive cooling to the entire room. Motion sensor lighting, occupancy sensors, dim lighting and blacking out windows will provide additional power savings by reducing the heat load in the data center. IIT expects a 25% reduction in power usage at the completion of the data center renovation. The current annual electrical load at the data center is 569,400 kWh and an estimated 25% reduction will result in a savings of 142,350 kWh and \$14,235.

Reduction in non-renewable energy: As IIT continues to move forward with the implementation of their “Technology Energy Management Plan” it has the potential to reduce the County’s non-renewable energy usage by 1,128,750 kWh annually and provide an estimated annual savings of \$112,875.

Investment: The Data Center renovation project is scheduled to begin in FY2010. The renovation is projected to cost \$471,000.

(Lead Agency = IIT Division)

Buildings Recommendation 2.11: Convert existing traffic lights to light-emitting diode (LED) technology by 2012 and use LED technology in all future installations.

The traditional incandescent traffic lights use between 65 and 135 watts each while LED traffic lights use between 6 and 15 watts, depending on the size, color and type. LED traffic lights consume 80 to 90% less energy than incandescent bulbs and generally last up to 10 years, compared to the average 2 years for incandescent bulbs. It is becoming a standard process across the country for signal lighting to be converted from incandescent to LED.

Signal lights, crosswalks, warning signals, and emergency flashing signals for fire departments would all be a part of the replacement plan.

Besides energy conservation, there are other benefits to this conversion. Incandescent traffic-signal lights typically require replacement every two years. But the lifespan of LED lights is up to 10 years in part because the numerous pinpoints of lights in an LED lamp do not all burn out at one time. Fewer burned-out traffic lights improve the public safety of County roads and intersections. Additional savings in manpower and expenses result from the greatly reduced frequency of bulb change outs. The conversion process itself nets no new labor costs as the change out can be done during the normal replacement cycle of the incandescent lights.

The County and the State each have ownership of traffic lights at specific intersections throughout the County. There are also shared intersections where the County is responsible for the electricity bills and the State is responsible for the maintenance. As part of Governor O'Malley's EmPOWER Maryland initiative that requires the State to reduce energy consumption by 15% by 2015 State Highway Administration (SHA) is upgrading all existing traffic signals owned or operated by SHA to LEDs. The annual energy savings will then cover the loan repayments for the life of the conversion project, estimated to be no longer than 15 years.

There are 16 signal light intersections (including traffic lights, crosswalk, and warning signals) that are the complete responsibility of the County. These intersections have a total of 210 incandescent lights and 330 LED lights.

Reduction in non-renewable energy: If the County's 210 incandescent traffic lights were converted to LED in FY2011 and FY2012 the County would save an estimated 164,000 kWh of electricity annually. Over the life of the bulbs (assuming they only last 5 years) the energy saved would total 820,000 kWh.

Investment: The one-time cost to convert the 210 lights to LED is estimated to be \$15,000.

(Lead Agency = Division of Public Works)

Buildings Recommendation 2.12: Establish guidelines for County leased space to meet the energy efficiency standards for County-owned buildings.

Approximately 5 percent of the County's overall building space is leased space. The energy efficiency of leased space is as important as the energy efficiency of owned space. While the County as lessee does not have the same control over the construction and operation of a building as it does with buildings it owns, there are steps the County can take to ensure leased space has a high level of energy efficiency. The following action plan should become a standard operating procedure for lease acquisition:

1. Review energy efficiency ratings of mechanical and electrical equipment
2. Review energy efficiency of building envelope (roof, walls, windows, insulation, etc)
3. Review energy bills for a recent 12-month period
4. Rank energy efficiency using ENERGY STAR Portfolio Management
5. On leases of 3,000 square feet or more and terms longer than 3 years, target an energy efficiency rating of 50 or greater in ENERGY STAR Portfolio Manager.
6. For leased locations where major leasehold improvements will be constructed for the County and tenancy will likely extend 8 years or more, construction design should include the same energy efficiency standards as for owned space.
7. Lease recommendations to the County Commissioners should include a section on energy efficiency and an estimate of the ENERGY STAR Portfolio Manager ranking.

The following is recommended for currently-leased property:

8. Current long-term leased space should be audited for energy efficiency in the same manner as owned space. Reasonable energy efficiency improvements that are projected to have at least a 75% payback during the County's expected occupancy period should be implemented.

This recommendation would benefit the County while occupying the space and also provide a benefit to the community when the lease is expired by leaving the property in an environmentally improved condition and increasing the value of the property.

Reduction in non-renewable energy: Reduction in non-renewable energy use will be dependent on the amount of space the County leases over the next 15 years. Assuming energy efficiency improvements in existing leased space provide a 20% reduction in energy use this recommendation would result in 1% reduction in the County's electricity and natural gas consumption.

Investment: Investment will vary depending on the number of leases required over the next 15 years to meet County space needs.

(Lead Agency = Management Services Division)

Buildings Recommendation 2.13: Adopt policies to regulate the number of personal appliances in County buildings and require that new appliances, electronics and office equipment meet or exceed ENERGY STAR certification requirements.

Regulate personal appliances

While there is a legitimate use for refrigerators, freezers, microwaves and coffee machines in the workplace, significant amounts of energy are wasted if a) there are more personal appliances than needed, b) the appliances used are not sized properly or c) the appliances do not meet available high efficiency standards. As a part of this recommendation personal appliances should be removed from individual offices and workspaces and instead be centralized and properly sized for general use.

A recent survey of County office buildings found the following appliances in individual offices or work spaces excluding appliances located in lunchrooms or break rooms for general employee use:

No.	Appliance	Annual Use Per Appliance		Annual Use - Total All	
		kWh	\$	kWh	\$
62	Mini-Refrigerators	300	\$30	18,600	\$1,860
17	Med.-sized refrigerators	400	\$40	6,800	\$680
53	Coffee makers	420	\$42	22,260	\$2,226
TOTAL				47,660	\$4,766

If two-thirds of the mini-refrigerators and one-half of the medium-sized refrigerators and coffee makers were removed, the County would save approximately 27,000 kWh and \$2,700 per year.

Purchasing ENERGY STAR rated equipment

Using ENERGY STAR certified equipment ensures appliances and other equipment are at the higher end of energy efficiency. The main goal of the DOE's ENERGY STAR program is to develop performance-based specifications to determine the most efficient products in a particular category. Higher efficiency units then earn the ENERGY STAR rating which the manufacturers are permitted to promote with the unit.

ENERGY STAR products offer several key benefits³:

- Reducing energy use 25 to 50 percent per product
- Lifetime decrease in operation and maintenance costs
- Significant return on investment over the life of the product
- Extended product life

³ Reference: ENERGY STAR website www.energystar.gov

ENERGY STAR certification is available for a variety of products:

- Household appliances (refrigerators and freezers such as the ones used in various departments)
- Other commercial products (windows, roof products and vending machines)
- Lighting (CFL light bulbs, light fixtures, and exit lights)
- Office equipment (computers, copiers and fax machines, monitors, mail machines, televisions, water coolers, etc.)

An effective way to enforce the use of ENERGY STAR qualified products is to include an ENERGY STAR requirement in the organization's purchasing regulations.

Reduction in non-renewable energy: Limiting the number of personal appliances in offices will reduce electricity consumption by 27,000 kWh's per year. While we do not have enough data to project the energy reductions for the use of ENERGY STAR appliances, we know that these appliances use significantly less energy than conventional appliances.

Investment: There would be no cost to reducing the number of personal appliances in offices. Although purchasing ENERGY STAR rated equipment would add some cost to future equipment and construction purchases, in general there is a complete payback from energy savings over less than the life of the equipment.

(Lead Agency = Management Services Division)

Buildings Recommendation 2.14: *Use roofing materials that minimize heat absorption in new construction and roof replacement projects.*

Cool roofs are recommended as a standard practice when constructing a new building or replacing an existing roof. By reflecting heat from the sun, cool roofs reduce the absorption of heat into a building's conditioned space. This reduces overall energy consumption since in our climate more energy is used for cooling than for heating in occupied office buildings.

The maintenance of a cool roof is the same as a standard roof. Maintenance includes annual inspections and keeping roof drains free of debris.

Conventional dark roofs, such as the more conventional synthetic rubber roofing EPDM (ethylene propylene diene monomer) absorb 70 percent or more of the sun's solar energy and can exceed 190 degrees Fahrenheit, while a cool roof that is usually white or light colored absorbs less than 35 percent of the sun's energy and rarely exceeds 120 degrees Fahrenheit, even on a 90-degree day.

Thermoplastic polyolefin (TPO) is a blend of polymers that may or may not contain desirable additives such as flame-retardants or UV absorbers. A TPO roof can last 30 years and is largely maintenance free.

The Health Department roof was replaced in March 2009 with the County's first TPO roof. Over the next year three years 5 additional roofs are to be replaced with TPO roofing:

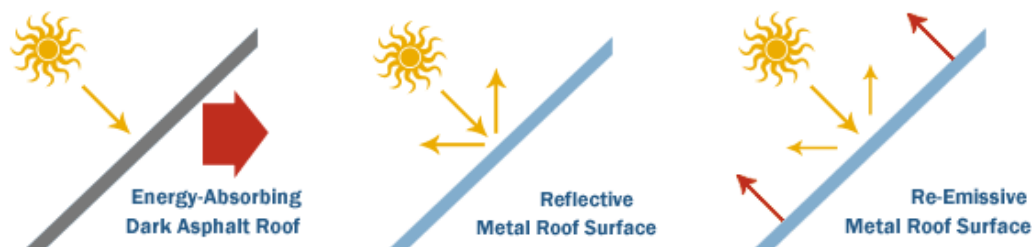
- Advanced Life Support
- Parks Shop
- Animal Control
- Emmitsburg Community Center
- Winchester Hall West Wing

Reflective metal finishes - Manufacturers have recently developed cool metal roofing products that use pigments that reflect infrared radiation, further increasing the solar reflectance of metal roofing, keeping it cooler. White-painted metal roofing has the highest solar reflectance value of any roofing product available.

The three figures shown in Figure 5 below show the difference an asphalt roof can make compared with reflective and re-emissive metal roofs. The unpainted metal roof will reflect much of the solar radiation usually absorbed by an asphalt roof. Pre-painted or granular coated metal roofing not only reflect but cool by re-emitting most of what solar radiation is absorbed.⁴

⁴ Reference: <http://www.metalroofing.com/v2/content/guide/costs/energy-savings.cfm>

Figure 5: Comparison of asphalt, reflective metal and re-emissive metal roofs



Green roofs also known as vegetated roofs or eco-roofs are thin layers of living vegetation installed on top of conventional flat or sloping roofs.

There are several benefits connected with green roofs:

- Control storm water runoff
- Savings on energy heating and cooling costs
- Prolonging the life of the roof
- Reduce sound reflection
- Improve air quality

The Catoctin Creek Nature Center in the CIP program will be designed utilizing “green” building concepts including the installation of a vegetated roof.

Reduction in non-renewable energy: The use of low heat roofing, projected to be primarily TPO, on roof replacement projects has the potential to reduce 175,000 kWh of electricity per year. Heating costs will increase by approximately 4,800 therms.

Investment: TPO roofing typically cost 5% more than the conventional EPDM roofing. For the County’s 14 roofs to be replaced over the next 15 years that are candidates for TPO roofing, the total additional cost is estimated to be \$85,000. With a minimum 20-year warranty, TPO roofing will have a 200% payback over the expected life of the roof.

(Lead Agency = Management Services Division)

Buildings Recommendation 2.15: Use a third party commissioning agent for all new construction and renovation projects to verify energy-related systems (HVAC and electrical) are designed, installed and calibrated to perform as intended and achieve maximum energy efficiency. Perform retro-commissioning of existing buildings on a systematic basis.

Commissioning, as defined by American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), is "a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria".

Commissioning is an "umbrella" process for the planning, delivery, and verification of critical functions performed in, or by, facilities. Commissioning uncovers deficiencies in design or installation using peer review and field verification. Commissioning accomplishes higher energy efficiency, environmental health, and occupant safety and improves indoor air quality. Commissioning is a quality assurance-based process that delivers preventive and predictive maintenance plans, tailored operating manuals, and training procedures. Essentially, the commissioning process formalizes review and integration of all project expectations during planning, design, construction, and occupancy phases by inspection and functional performance testing, and oversight of operator training and record documentation. Additional information on commissioning is available in Appendix F.

Governmental projects commonly employ commissioning because mission critical facilities support essential public infrastructures. Corporations use commissioning on projects to prevent "down-time" that can adversely impact bottom lines and business continuity. Manufacturers use commissioning because of high levels of environmental controls needed in process manufacturing and to ensure occupational safety in hazardous settings.

Commissioning ensures that fundamental building elements and systems are designed, installed, calibrated and operating as intended so they can deliver functional and efficient performance. A comprehensive building commissioning program includes the following:

1. Developing a comprehensive building operation plan that meets the requirements of current building usage, and addresses the heating and cooling system, humidity control, lighting, safety systems and the building automation controls.
2. Reviewing plans during the project design phase to ensure the building operation plan will be achieved.
3. Testing all building systems to verify that they are working according to the specifications of the building operation plan and document the findings.
4. Repairing or modifying systems components not working according to the specifications of the building operation plan.

5. Re-testing building components that required repairs or modifications to verify that they are working according to the specifications of the building operation plan.

Reduction in non-renewable energy: Based on a review of several studies, commissioning has the potential to reduce energy cost anywhere from 5% to 30% in both new buildings and existing buildings. Since this Plan includes many recommendations for buildings that overlap in providing energy savings and because work has already been done to improve the energy efficiency of many County buildings, the projected energy reduction from commissioning is conservatively placed at 5%.

Investment: Based on a study conducted by Evan Mills in 2009 for the Department of Energy, median commissioning costs are \$1.16 per square foot for new construction and \$0.30 per square foot for retro-commissioning. One-time retro-commissioning of existing County occupied buildings would cost approximately \$300,000. Again, based a review of several studies, and using an estimated 5% resulting energy reduction, payback would be achieved in approximately 2.5 years.

(Lead Agency = Division of Public Works)

Building Recommendation 2.16: Consolidate general County government offices into a single high-energy-efficient building.

While the current economic downturn may defer consideration of this recommendation to a future time, significant energy savings are possible from a physical consolidation of County office space. The County currently operates from five general government office buildings in downtown Frederick:

Building	Size (square feet)	Electricity (kWh)	Natural Gas (therms)
520 N. Market St.	25,742	591,120	34,264
118 N. Market St.	24,400	335,200	3,931
30 N. Market St.	24,500	330,240	4,252
Winchester Hall	78,800	1,736,800	17,643
IIT Building	8,971	183,480	5,984
TOTAL	<u>162,413</u>	<u>3,176,840</u>	<u>66,074</u>

The consolidation into a high efficiency building with an open-span design allowing the use of open work areas where feasible would result in reduced energy consumption from 2 main factors:

1. Reduction in required total building square feet by approximately 20% due to the efficiencies of modern architecture design. This would reduce the building square feet to 130,000 sq ft.
2. The energy efficiency of a new building could easily be 20% greater than the energy efficiencies of the existing buildings.

The combined effect of these factors is a 35% reduction in energy costs compared with operating the 5 current buildings.

In addition to the energy reductions of operating the new building described above, there are several additional benefits to be considered:

- Decrease in maintenance and custodial costs due to less square footage
- Decrease in maintenance costs due to more space under one roof and more maintenance-free design features.
- Improved communication and collaboration between Divisions and staff
- Non-public access areas could operate on more efficient work week (four 10-hr days)
- Added convenience to citizens by providing easier public access to several divisions in one building.

Reduction in non-renewable energy: Annual reductions in energy use are projected to be 1,100,000 kWh of electricity and 24,000 therms of natural gas.

Investment: A 130,000 square foot building constructed at a total project cost of \$250 per square foot would cost \$32,500,000. The existing buildings, if sold for \$130 per square foot would return \$21,100,000 resulting in a net capital outlay of \$11,400,000.

(Lead Agency = Management Services Division)

Buildings Recommendation 2.17: Utilize future energy-related technology advances as they become available to reduce the County's use of non-renewable energy.

Renewable energy and energy efficiency technology advances will be important to meeting the County Commissioner's strategic energy reduction goal. Some of these technology advances will offer the County new choices in the areas of renewable energy and energy efficiency. Other advances will be 'forced' on the marketplace through stricter governmental regulatory requirements.

Regulatory requirements as well as energy prices are anticipated to drive energy efficiencies in buildings. Building codes adopted by governments will likely continue to increase requirements for insulation, energy efficient lighting, energy efficient heating and cooling systems and energy management controls. Generally building codes are drafted around existing technology.

Federal government regulation of energy efficiency is often employed to drive the building industry to develop new technology. It is likely the Federal government will establish future energy efficiency standards for buildings and building systems that exceed current practice and technology in the same manner it has established fuel economy mandates for the auto industry.

Federal regulations are likely to force the marketplace to increased uses of renewable energy through mandates on federal agencies, stricter air quality standards, and pressure on the country's utility industry.

Industry groups are also able to influence the progress of energy efficiency. The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) establish industry standards for its members in matters of HVAC design and performance. Many building codes adopted by local governments base their standards for HVAC on the ASHRAE standards. ASHRAE will update HVAC efficiency standards (Standard 90.1) in 2010. The 90.1-2010 Standards Committee is expected to increase equipment efficiency requirements based on the most cost-effective and newest technologies available.⁵

The National Renewable Energy Laboratory is leading the nation's research effort in renewable energy technologies. Technologies in development will reach the marketplace over the next 10 years. Technology improvements in the past five years have been impressive and include:

- Heating and cooling system manufacture have improved energy efficiency of equipment by 30%.
- Appliance manufacturers have improved energy efficiency by 40%.

⁵ Reference: www.facilitiesnet.com/bom/articlePrint.asp?id=10879

- Solar technology improvements have increased power output for the same-sized solar panel by 150%.
- Lighting fixtures and bulb applications along with light-emitting diode (LED) technology has reduced energy consumed for building by 75% or more.
- Growing use in the U.S. of variable refrigerant volume (VRV) HVAC systems that have higher efficiency ratings than traditional HVAC system designs, and often include the capability to transfer heat within a building

The following are examples of energy-related technology innovations in the works:

- Department of Energy Solar Energy Technologies Program focuses on developing cost-effective solar-energy technologies and reducing regulatory, technical and financial barriers to integrating solar energy into the electricity supply grid.
- Light-Emitting-Diode Technology (LED) is expected to replace non-task lighting applications in buildings by 2020.
- Improved Energy Storage: The demand for electricity is seldom constant over time. Many renewable resources such as wind and solar power are intermittent and the maximum benefit from these sources is obtained when electricity produced during off-peak times can be stored for later use. Battery technology is steadily improving to increase the longevity and cost effectiveness of energy storage.
- Fuel cell technology: Fuel cells harness the chemical energy of hydrogen to generate electricity without combustion or pollution. Fuel cell technology is in an early development stage, needing improvements in efficiency and durability to be usable and cost-effective.

Reduction in non-renewable energy: Over the next 15 years technology improvements along with tougher governmental regulations will provide the impetus and means for reducing energy consumption in County buildings by 15%. In addition, improving renewable energy technologies will make possible an additional 5% conversion to renewable energy sources.

Investment: There is no way to project the additional cost of new or improving technologies in the area of energy efficiency and renewable energy. If the past adequately predicts the future, costs will be higher for technology but costs will also be rising for the energy usage that is avoided by use of the new technologies.

(Lead Agency = Management Services Division)

3.0 FLEET

Background

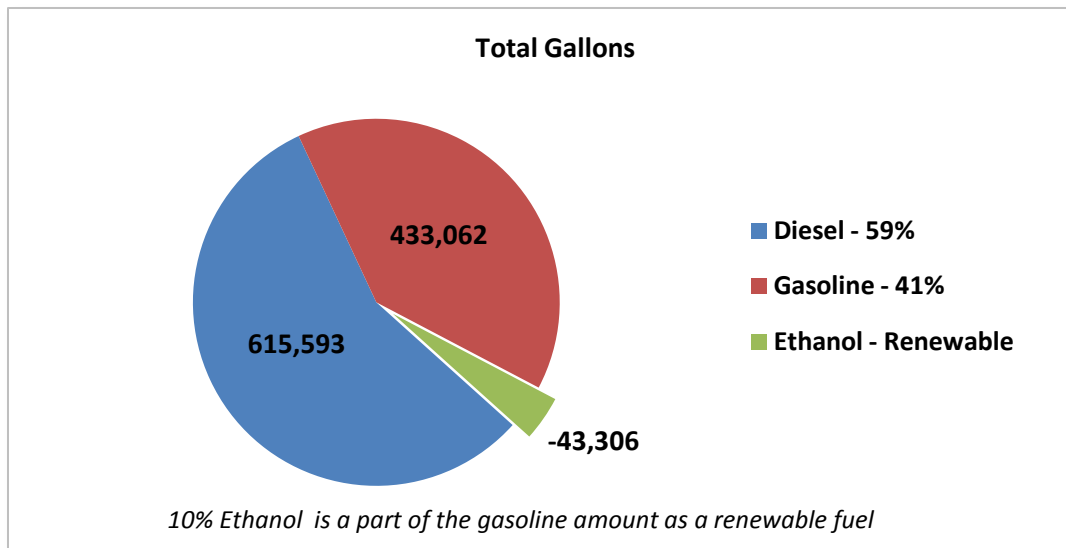
Fleet Work Group

The Fleet Work Group includes employees from the Highway Operations, Management Services, Sheriff's Office, Transit and the Fleet Shop. The fleet committee members have expertise in fleet operations, vehicle maintenance, specification writing, and fueling systems.

The Fleet Work Group compiled vehicle and fuel consumption data, reviewed data from CQI Associates, analyzed vehicle fuel usage by class of vehicle, and participated in the development of recommendations for reducing non-renewable fuel usage in County vehicles by 50 percent by 2024.

Baseline Fuel Use

Frederick County's vehicle and equipment inventory includes 885 powered vehicles. Of the total 734 are categorized as on-road vehicles (buses, sedans, trucks, SUVs, and vans), and 151 are categorized as off-road equipment (backhoes, graders, mowers, and loaders). Fiscal year 2007 was selected as the baseline for fuel consumption. During FY2007 the fleet used 1,048,655 gallons of fuel including 615,593 gallons of diesel fuel and 433,062 gallons of gasoline. Because of federal government air quality regulations, gasoline dispensed in our area must be oxygenated to reduce harmful emissions from the fuel combustion. Unleaded fuel is oxygenated with a 10 percent blend of ethanol, which is a renewable energy source. Accounting for this existing use of ethanol in County fuel, the non-renewable vehicle fuel baseline is 1,005,349 gallons. Shown in Figure 6 below are the percentages along with the total gallons consumed during the FY2007 baseline period.

Figure 6: FY2007 Baseline Fuel Consumption

Target fuel consumption reduction

The Fleet Work Group accepted a target fuel reduction of 50%. This matches the overall non-renewable energy reduction goal of the County Commissioner's strategic plan even though the strategic plan does not require a 50% reduction from every energy-use sector of County government. Based on the baseline gallons, the target is a reduction of non-renewable energy consumption of 502,662 gallons, through a combination of conservation and conversion to renewable fuels.

Current conservation practices

Even before the development of the Plan, the County and the Fleet Services Department have implemented several conservation and efficiency strategies for the County vehicle fleet.

Preventative maintenance

Fleet Services provides comprehensive preventative maintenance (PM) service for County-owned vehicles and equipment. Most PM schedules are based on the vehicle manufacturer recommendations. For many vehicle types it is necessary to modify PM schedules in response to operational concerns such as emergency vehicles that may sit with engines running while not accumulating road miles. Vehicles over 10,000 lbs gross vehicle weight are subject to State and Federal regulations for safety inspections and PM. Along with routine safety inspections and fluid changes, Fleet Services keeps the County's fleet in compliance with these regulations as well. Fleet Services uses an industry-leading vehicle maintenance management software application (CCG Faster) to track and control vehicle inventory, PM schedules, and vehicle maintenance activity.

Synthetic oil program

With a focus on efficiency and cost reduction, Fleet Services has transitioned to synthetic automotive fluids in differentials, transmissions and a few engines. This is done to reduce, and in some cases nearly eliminate, routine fluid drains. Superior lubricating properties of synthetic fluids reduce friction and allow for extended drain intervals. Differentials and transmissions are good candidates for synthetic fluids because they are essentially closed systems so dirt becomes less of a factor in dictating service intervals. Fleet Services continues to test synthetic oil in various engine applications to determine the cost savings benefits. From Fleet Services experience, one of the industry expectations of synthetic engine oil that has not materialized is improved fuel economy.

Hybrid vehicles

Since 2007 the County has purchased nineteen hybrid vehicles; they include: Ford Escapes (5), Chevrolet Malibu (7), Toyota Prius (5), and Honda Civics (2).

Fuel conservation directives

In the summer of 2008, the County Manager directed Divisions to take meaningful measures to reduce fuel consumption. Divisions were directed to:

1. Implement fuel conservation plans to reduce fuel consumption by 10% (3% for Transit).
2. Eliminate idling of all vehicles and equipment except when required for performing essential functions.
3. Eliminate out-of-County travel in County vehicles with fuel economy under 22 MPG on the highway unless 4 or more people are traveling together.

As of August 2009 (52 weeks under these directives) County employees have reduced fuel consumption by 7.1%.

CQI Associates Fleet Assessment

CQI Associates was contracted to conduct a thorough review of the County's vehicle fleet. CQI's analyses, report and recommendations form the basis for many of the fleet recommendations in this Plan. Some of the analysis in the CQI Associates report includes:

1. Comparison of fuel consumption for the current fleet with fuel consumption of the fleet if each vehicle were 'best-in-class' for fuel efficiency.
2. Fuel-savings potential of hybrid vehicles.
3. Best practices for fleet maintenance and procurement standards.
4. Discussion of fuel options including gasoline, biodiesel, and E-85.

CQI Associate's "Transportation Assessment Study" of the County's fleet (Appendix G) categorized vehicles as:

- General vehicles (sedans, SUVs, and vans)
- Trucks (pick-ups, utility trucks, small and large dump trucks)
- Public safety vehicles (cruisers and emergency response SUVs)
- Buses

The fleet assessment by CQI Associates analyzed a number of alternatives for reducing non-renewable fuel consumption. The majority of the analysis excludes off-road equipment and fire apparatus. Fuel consumption for these vehicles is primarily a factor of the time they operate on the job rather than the miles that they travel. Despite the exclusion from the CQI Associates analysis, the total fuel consumption of these vehicles is included in the baseline year total and is subject to the non-renewable fuel reduction goal.

FLEET RECOMMENDATIONS

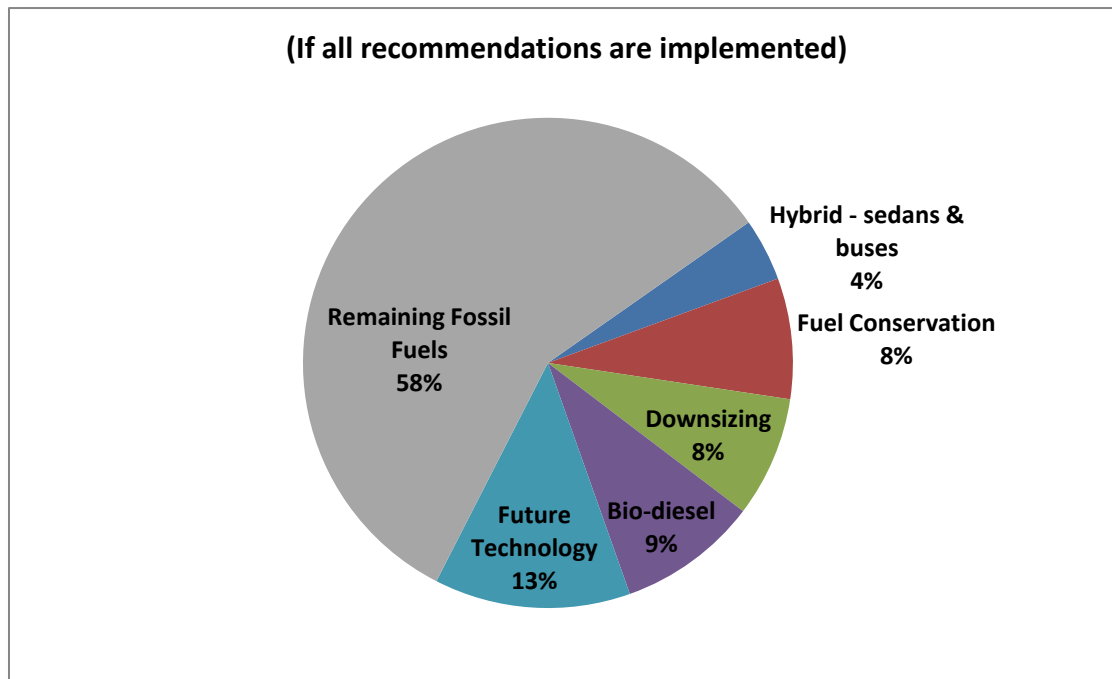
In the following section fleet-related recommendations are presented for reaching the County Commissioner's strategic energy reduction goal. The recommendations are based on the work of the Fleet Work Group, input from CQI Associates and the findings in the Transportation Assessment completed by CQI Associates.

The overall analyses suggest that strategies based on the following main areas will meet the energy reduction goal:

- Implementing the fuel conservation plan and down-sizing of fleet vehicles will reduce the amount of fossil fuel consumed by up to 19%.
- Conversion to bio-diesel blends will achieve up to a 12% conversion to a renewable energy.
- Continued conversion to hybrid vehicle technology in the general vehicle fleet (sedans, SUVs, trucks) and transit buses will achieve up to a 6% conversion to a renewable energy.
- Technology advances that are in research and development could achieve up to a 15% reduction in non-renewable fuel use. This could include electric vehicle technology, expanded use of hybrid technology for trucks, advances in engine technology, and hydrogen-based fuel cell technology.

Cumulative Effect

Shown in Figure 7 below is the breakdown of the cumulative effect of each main strategy on reaching the reduction goal.

Figure 7: Non-Renewable Energy Reduction of Fleet-Related Energy Usage by 2024

If all proposed recommendations are implemented the cumulative effect will be a reduction of 42% in fleet-related consumption of non-renewable energy. Approximately 55% of the reduction would be achieved through conservation and 45% through conversion to renewable energy sources by 2024.

Fleet Recommendation 3.1: Continue active fuel conservation by all Divisions under the 2008 10-Percent Fuel Conservation Plan.

In 2008, at the direction of the County Manager, every Division implemented a fuel conservation plan designed to reduce fuel consumption by 10%. Because of the importance of public transportation in the broader public policy arena of sustainable fuel consumption, the conservation goal for Transit was set at 3%. The 2008 Fuel Conservation directive was primarily a response to rapidly escalating fuel prices and predictions of budget shortfalls brought on by the economic downturn.

Examples of conservation measures implemented by County Divisions include:

- Reduction in warehouse delivery days from 5 to 4 per week
- Four 10-hour workdays in Highway Operations from April to October
- Increased carpooling
- Reduction in take-home vehicle use
- Fueling at the closest fueling site even if it is not a County-owned site
- Using the highest-rated MPG vehicle available for the job
- Improving driver awareness of fuel efficient driving techniques

To provide feedback and motivation to County employees a fuel conservation report was issued from the County Manager's Office every 8 weeks detailing each department's performance against the baseline period. Appendix H provides the percentage reduction results from each of the County Divisions for the first fifty-two weeks of the 2008 Fuel Conservation Plan.

The County Commissioners and County Manager have directed Divisions to continue with the fuel conservation program through FY2010.

Reduction of non-renewable energy: If Transit attains its 3 percent reduction goal and all other Divisions attain the 10 percent conservation goal, the overall result will be an 8.5 percent (85,000 gallon) reduction in fuel usage.

Investment: There is no cost related to the implementation of the fuel conservation plan. The changes are operational and do not require either one-time or ongoing expenses.

(Lead Agency = Fuel Conservation Committee)

Fleet Recommendation 3.2: Convert diesel fuel to a 20% bio-diesel blend (B20) in the summer months and a 5% bio-diesel blend (B5) in the winter months beginning summer of 2011. As diesel engine technology improves and new vehicles are purchased the goal is to operate year-round using a 20% bio-diesel blend.

Bio-diesel is a clean burning alternative fuel produced from renewable organic resources such as vegetable, soybean, canola or hemp oils, or animal fats. Pure bio-diesel contains no petroleum. However, bio-diesel can be blended in a variety of concentrations with petroleum diesel to create a bio-diesel blend. It can be used in compression-ignition (diesel) engines with no major modifications. Bio-diesel is simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatics.

While most fleets using bio-diesel today are using blends ranging from B5 to B20, some are operating on a B50 mixture.

The standard storage and handling procedures used for petroleum diesel can be used for bio-diesel. To begin using bio-diesel the County's current storage tanks would require a complete cleaning to remove any accumulated deposits on the tank walls.

The most common problem encountered with bio-diesel is that it thickens or 'gels' at a higher temperature than petroleum diesel fuel. Fuel that has gelled can block fuel lines, clog filters and impede injector performance causing engines to shut down. Because of the tendency to gel, the 'bio' portion of biodiesel is often reduced during cold weather.

Reduction in non-renewable energy: An initial conversion to a combination of B5 and B20 bio-diesel blends will transition 92,000 gallons of vehicle fuel annually to a renewable fuel, which represents a 9.2% reduction in overall non-renewable fuel usage. When engine technology advances allow for the year-round use of B20, a total of 123,000 gallons will be converted to a renewable fuel representing a 12.3% reduction in non-renewable fuel consumption.

Investment: The one-time cost to clean the eight diesel fuel tanks in preparation for the use of bio-diesel is estimated to be \$8,000.

Based on current market pricing, B20 costs \$0.22 more than petroleum diesel and B5 costs \$0.13 more per gallon. If this recommendation is implemented it will add \$108,000 to the County's annual vehicle fuel expense. It is expected that the premium cost for bio-diesel will be reduced as nationwide demand increases and technologies for manufacturing bio-diesel blends improve.

(Lead Agency = Management Services Division)

Fleet Recommendation 3.3: Purchase gasoline/electric hybrid sedans and light trucks when possible as vehicles are replaced as a conversion to a renewable energy source.

Hybrid vehicles combine the internal combustion engine of a conventional vehicle with the high-voltage battery and electric motor of an electric vehicle. A hybrid's electric motor is energized by a battery, which produces power through a chemical reaction. The battery is continuously recharged by a generator driven by the internal combustion engine and the forward momentum of the vehicle.⁶

There are several advantages of hybrid vehicles over conventional vehicles:

- Greater operating efficiency because hybrids use regenerative braking, which uses the energy to slow a vehicle to recharge the vehicle's battery rather than dissipating the energy as excess heat as is the case in traditional vehicles.
- Lighter engines because hybrid engines can be sized to accommodate average load, not peak load, which reduces the engine's weight
- Greater fuel economy, because hybrids consume considerably less fuel than vehicles powered by gasoline alone
- Lower maintenance costs in brake replacement, and less routine scheduled maintenance.

Hybrid vehicles cost more than conventional vehicles but, depending on fuel price, most if not all the premium is offset by fuel savings over the life of the vehicle.

Below in Table 3 compares the MPG's of conventional vehicles in the County's fleet with the compatible hybrid vehicle.

Table 3: Conventional vehicle versus a Hybrid alternative

Vehicle Type	Conventional	MPG	Hybrid Alternative	MPG	Annual Fuel Saved (gals)
Compact Sedan	Chevrolet Cobalt	22	Honda Civic	40	-307
Mid-size Sedan	Chevrolet Malibu (non-hybrid)	22	Chevrolet Malibu	27	-126
SUV	Ford Escape	23	Ford Escape FWD	32	-183
Pick-up Truck	Ford F150 2WD	17	Chevrolet Silverado 2WD	21	-168

Estimated fuel savings calculated assuming vehicles drive 15,000 miles per year. MPG figures are from the 2008 Fuel Economy Guide located at www.fueleconomy.gov except the Chevrolet Silverado which is based on 2009 model.

⁶ Reference: National Renewable Energy Laboratory website
http://www.nrel.gov/features/20060801_plugin_hybrids.html

Currently there are 19 hybrids in the County's fleet including 2 Honda Civics, 5 Toyota Prius's, 5 Ford Escape SUV's and 7 Chevrolet Malibu's.

Reduction in non-renewable energy: Based on information in the fleet analysis prepared by CQI Associates dated April 30, 2009, a conversion to gasoline/electric hybrid of all compact and mid-size sedans, as well as all compact SUV's and ½-ton pickup trucks would result in a conversion of 14,900 gallons of fossil-fuel per year.

Investment: In the 2009 model year hybrid vehicles purchased on the Maryland State contract cost between \$7,000 and \$10,000 more than their non-hybrid counterpart. Whether there is a net savings after reduced fuel consumption is factored in depends on the vehicle type and the cost of fuel. Compact sedans will generally break-even over an average life span of 8 years because of the 82% increase in fuel efficiency. On the other hand mid-size sedans will have a net cost associated with their purchase because there is only a 22% increase in fuel efficiency.

(Lead Agency = Management Services Division)

Fleet Recommendation 3.4: Purchase hybrid transit buses whenever 90 percent federal funding is available for such purchases.

There are currently twenty-three large buses (29- and 30-passenger) in the Transit fleet. Transit operates most days on a 16-hour schedule, and contributes to 21% of the County's total fuel consumption and 35% of the County's diesel consumption. As a large consumer of fuel with low MPG buses (average 3.84 MPG), engine advances for transit vehicles have a substantial impact on the County's reduction of non-renewable fuel usage.

Diesel/electric hybrid buses are becoming the bus of choice for many public transit systems for improving energy efficiency and reducing environmental impact.

Hybrid buses are equipped with smaller, cleaner burning diesel engines with quicker acceleration than conventional diesel-only buses. The engine is connected to a generator that produces electricity which is stored in the vehicle's battery. The electric motor drives the vehicle and acts as a generator to capture energy during regenerative braking to charge the batteries. In addition to fuel savings, this results in quieter rides and lower brake maintenance costs.

Hybrid transit buses are reported to average 5.1 MPG. That is a 33% increase in efficiency over the County's current diesel-only buses. Each large bus that is replaced with a hybrid will save an average 1,600 gallons of fuel each year.

In September 2008 Howard County introduced a diesel electric hybrid bus in its fleet. Howard County anticipates the bus will consume 35% less fuel than comparable diesel buses and cost 30 to 50% less for maintenance and repairs. (*News Release Sept 15, 2008*)

According to the American Public Transportation Association (APTA) although there is better fuel mileage with hybrid buses the additional costs (\$200,000+) will make it almost impossible to recoup the extra costs for the initial purchase from fuel savings. For this reason this recommendation is linked to the availability of federal funding.

Over time, engineering and technological developments are expected to increase the payback for hybrid buses. For example, researchers from the Massachusetts Institute of Technology (MIT) released a report on making lithium ion batteries much more efficient. In a test they were able to charge a lithium ion phosphate battery in 20 seconds, when compared to a standard battery that would take 6 minutes. The new batteries are able to retain charges longer, which could make the batteries smaller and lighter than existing lithium ion ones.⁷

This technology would further improve the fuel economy of buses and other hybrid vehicles.

⁷ Reference: www.masstransitmag.com/interactive/2009/03/13/hybrid-energy-solution/

Reduction in non-renewable energy: Based on a total of 630,000 miles per year for large transit buses, if all 23 buses were replaced with hybrid buses fuel consumption would be a conversion by 40,000 gallons per year.

Investment: Hybrid transit buses cost approximately \$200,000 more than diesel engine buses. To the extent that federal transit funding is available, the County's cost would be \$20,000 per bus.

(Lead Agency = Transit Division)

Fleet Recommendation 3.5: *Down-size vehicles to the most fuel-efficient vehicle that can perform the job. Focus purchase decisions on right-sizing vehicles to meet the user's job requirements rather than user preferences.*

This recommendation is focused on specifying the most fuel-efficient vehicle for the job. Consider the difference in using a 40 MPG hybrid sedan for basic transportation in place of a 14 MPG ½-ton pick-up truck. If the vehicle is driven 12,000 miles a year fossil fuel usage will be reduced by 500 gallons per year. Extend this to the County's fleet of 41 ½-ton pickup trucks. If even 10 of these trucks were replaced by hybrid sedans, fossil fuel consumption would be reduced by 5,000 gallons which equates to .5% of the total baseline fuel consumption.

Some of the 'traps' leading to over-specifying vehicles:

- Replacing vehicles like-for-like without evaluating the job function
- Not considering sedans for inspectors and utility personnel (many jurisdictions use sedans for inspectors with great success)
- Designing vehicle specifications for the worst case use even though it may only be occasional
- Providing all employees in the same job classification the identical vehicle even though some require fewer features
- Buying full-sized pickups when a compact pickup truck will do the job
- Believing that a compact car is not an appropriate work vehicle

Reduction in non-renewable energy: Based on the fleet assessment conducted by CQI Associates dated April 30, 2009, downsizing and right-sizing the vehicle fleet can result in up to a 10% or 100,000 gallon reduction in overall fuel consumption.

Investment: In general the capital investment in a down-sized fleet will be less than the current level of investment. However, this will not be true with every vehicle. For example, compact pickup trucks cost more than full-size ½-ton pickups even though they are lighter duty. Factors that can affect pricing include manufacturing quantities, governmental bid incentives offered by manufacturers and overall marketplace demand for particular vehicle types. We believe that by 2024, downsizing of the fleet could reduce vehicle purchase costs by 3% or approximately \$85,000 per year.

(Lead Agency = Management Services Division)

Fleet Recommendation 3.6: Utilize teleconferencing and webinar capabilities in County facilities to reduce staff travel to meetings.

Meetings seem inevitable to ensure government functions effectively. With County employees located in 53 buildings around the County, thousands of miles per year are driven for the sole purpose of attending meetings. Some of this travel could be eliminated if teleconferencing and webinars were more widely used. The County's phone system allows for teleconferencing from employees' workstations and for small groups to teleconference from conference rooms with others in remote locations. With webcam technology, video could be added to teleconferencing as well.

There are several advantages to teleconferencing and webinars:

- Reduction in vehicle fuel usage
- Reduction in vehicle wear and tear
- Increased productive time due to decrease in travel time
- Increased employee availability without having to schedule travel time.
- Many meetings may be more efficient as employees would have access to all the files in their office while 'attending' the teleconferenced or webinar meeting.

Most County phones already allow for up to a 6-party conference call. All internal conference calls are no charge to the user; however there is a \$0.10 per call for local external calls.

There are some phones throughout the County that are analog, which allow only a 3-party conference call (if the 'leader' has an analog phone). For conference calls up to 20 participants Verizon offers an instant meeting service that is available through IIT at a cost of \$0.06 per minute per participant.

Reduction in non-renewable energy: Approximately 2,200 gallons of fuel could be conserved annually. This is based on eliminating travel for 15 meetings a week with an average of 5 attendees traveling an average of 8 miles round trip.

Investment: For almost all internal conference calls, there would be no cost. Assuming there are 15 meetings per week (780 meetings per year) replaced by conference calls and one of the six callers for each meeting is a local external call (\$0.10 per call) the total additional operating cost for teleconferencing would be \$78.00 per year.

(Lead Agency = Office of Environmental Sustainability)

Fleet Recommendation 3.7: Investigate vehicle and fuel technology advancements annually to determine if they would benefit County operations and the reduction of non-renewable fuel consumption.

Vehicle technology improvements are expected to progress at record rates over the next few years, especially in the area of fuel efficiency. Improving fuel economy and using alternative fuels have been given a huge boost by:

1. The rapid rise in fuel prices in 2008.
2. The continued political instabilities and uncertainties of many foreign oil-producing countries.
3. The Obama administration's stimulus funding directed to new energy technologies.
4. Climate protection concerns related to by-products of petroleum fuel combustion.

Researchers are working on the following advanced vehicle systems:

The application of gasoline/electric hybrid vehicle technology is expanding to more makes and models. In 2008 there were 30 new hybrid electric vehicle models introduced.

Plug-in hybrids are the next generation of hybrid electric vehicles and should be offered by the major manufactures by 2011. Compared to standard hybrids, plug-in hybrid electric vehicles offer even greater fuel economy and diversity and fewer emissions.

Plug-in hybrids have a larger battery pack than a standard hybrid vehicle. This allows plug-in hybrids to operate predominantly on electricity for short trips. The plug-in hybrid battery can be recharged using a standard electrical outlet.

Fuel cell vehicles use hydrogen and oxygen to produce electricity. The electricity is then stored in a battery, which powers the vehicle's electric motor and other electronics. Fuel cells can provide auxiliary power for lights in vehicles or be used for vehicle propulsion. Fuel cell technology for vehicles should be available and cost effective in fifteen years.

Electric vehicles (EV) are powered solely by an electric motor. A battery is used to store the electricity and is replenished by plugging in the vehicle to a power source. EVs are considered zero-emission vehicles because their motor produces no exhaust or emissions. The current downside of EVs is that they can only go 150 miles (or less) before they need to be recharged and to fully charge the battery can take up to 8 hours.

Electric vehicle technology is available for light-duty utility vehicles for campus settings. They should be available and cost effective for larger vehicles and light-duty trucks in seven to twelve years.

Alternative fuels:

Compressed Natural Gas, Liquefied Natural Gas, propane and ethanol were studied for use by the County. While there is no recommendation to move forward with these fuels, advancements in technology and engineering may make vehicles powered by ethanol viable and cost-effective in the future.

Ethanol is a renewable fuel made from plants, produced by fermenting plant sugars. It can be made from corn, sugar cane, and other starchy agricultural products. The cellulose in agricultural wastes such as waste woods, and corn stalks (also known as cellulosic ethanol) can also be used as a base. Most light vehicle manufactures are producing some models that can use both petroleum fuel and fuel that is an 85 percent blend of ethanol (E85).

E85 is not a recommendation of the Plan at this time for several reasons:

- E85 vehicles are not available for all gasoline powered vehicle classes.
- E85 vehicles have significantly lower MPG's and many models cost more than traditional vehicles.
- Dedicated fueling sites are required (unlike diesel fueling sites that can be used for any bio-diesel blend).
- There remains uncertainty in the market about the viability of current ethanol sources (grains) due to high energy use in production, low energy output, and the tension created in the world food markets.

However, as higher output and less controversial sources of ethanol become more available and more flex-fuel vehicles are manufactured conversion to E85 fuel should be re-evaluated.

Reduction in non-renewable energy: The results of technology and engineering advances as well as stricter government regulations will contribute to the reduction of non-renewable fuels in 2 ways:

1. Many advances will become standard equipment as a result of regulatory pressures such as the federal Corporate Average Fuel Economy (CAFE) standards that require vehicle manufacturers to meet a specified fuel economy for the sum of the vehicles they sell or EPA air quality standards that create pressure to use cleaner-burning renewable fuel sources.
2. Other advances will be options made available to vehicle and fleet owners in their choice of vehicle or fuel type.

It is reasonable to expect engineering and technology advancements to enable a 10 to 15% reduction in non-renewable energy consumption over 15 years. This would amount to 100,000 – 150,000 gallon reduction in fossil fuel use by the County.

Investment: The cost to vehicle and fleet owners related to these future advancements is unknown.

(Lead Agency = Management Services Division)

4.0 UTILITIES AND SOLID WASTE FACILITIES

Background

This section of the Plan has been developed by the DUSWM. The material includes information previously presented to the BOCC in the form of several comprehensive staff reports as well as additional specific information on the LFGE and WTE projects.

Meeting the County Commissioners' Strategic Goal by 2024 while dealing with increasing electrical demand and escalating energy cost will be a significant challenge. Presently many renewable sources of electricity, such as wind and solar are more expensive than power produced from base-load sources such as coal-fired power plants, which are currently the dominant source of electricity supplied by the PJM Regional Transmission Organization (RTO).

Many government agencies as well as other organizations are setting goals to increase their use of renewable energy in part to help reduce greenhouse gas contributions associated with their operations. Examples of these actions include:

- Maryland 2001 Executive Order 01.01.2001.02, "Sustaining Maryland's Future with Clean Power, Green Buildings and Energy Efficiency".
- The U.S. Conference of Mayors Climate Action Protection Agreement supports a seven percent reduction in greenhouse gases from 1990 levels by 2012.

In Maryland, and many other states, energy, including electricity produced using landfill gas or the direct combustion of municipal solid waste (MSW) is considered renewable "green energy". Studies completed by the Environmental Protection Agency (EPA), the Solid Waste Association of North America (SWANA) and others have shown that waste management practices can have a significant impact on the generation of greenhouse gases. Furthermore energy recovery from MSW can offset emissions from base load fossil fuel power plants, resulting in even greater reductions of greenhouse gases. An example of these emission benefits specifically related to Frederick County's waste management practices is illustrated in (Appendix I) RTI International's July 28, 2008 report "Solid Waste Modeling Support for Frederick County, Maryland".

The County (DUSWM), through the Northeast Maryland Waste Disposal Authority (NMWDA) is currently developing two renewable energy projects, which have the potential to generate significant amounts of renewable electrical energy. Ultimately the County may want to rely on these projects to meet their renewable energy goals. Both projects would make significant contributions to meet the goal of reducing the use of non-renewable energy by 50% over the next 15 years; the WTE project has the potential to provide all of the County's electric supply needs from a renewable source of energy.

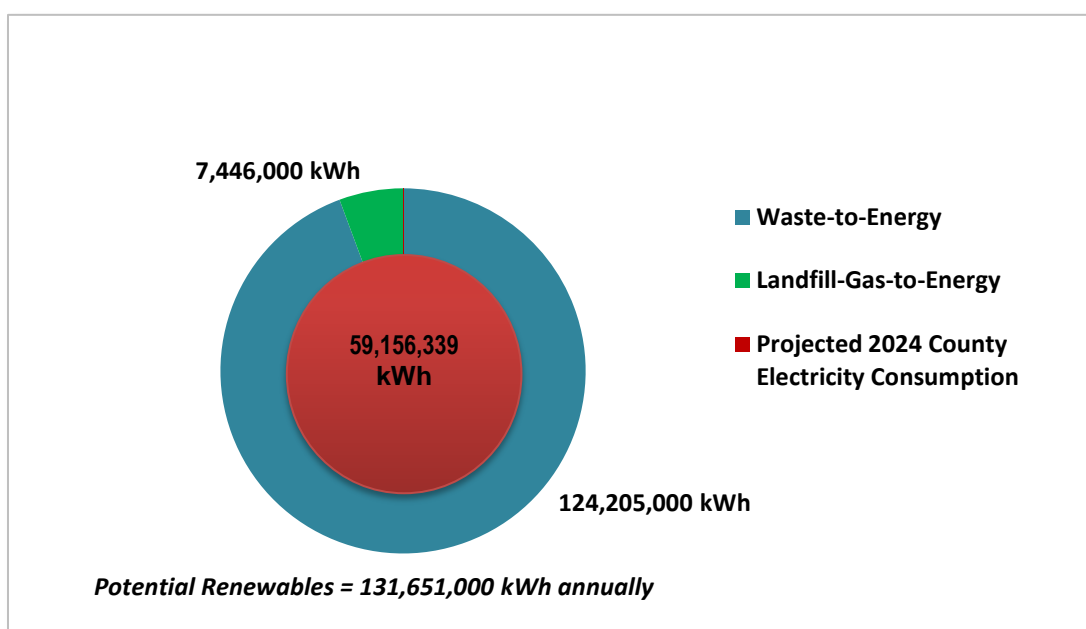
Opportunities also exist for the County to achieve certain short-term progress towards purchasing renewable energy generated from the Landfill Gas to Electricity project (LFGE),

which the DUSWM and the NMWD A are currently constructing at the Reich's Ford Road landfill. Renewable energy from this source will not be permanent but could provide 10 to 20 years of renewable electricity, which could provide a portion of the County's renewable electrical energy supply until 2030, when this supply will diminish to levels which make its use not economical. The LFGE project is scheduled to be completed in August 2010.

The County's long-term solid waste disposal program, which includes the construction of a regional Waste to Energy (WTE) facility, provides an opportunity to secure reliable renewable electrical energy, while at the same time reducing or eliminating one of the County's primary sources of GHG; methane gas generated as a result of the disposal of the County's solid waste. As the EPA's Municipal Solid Waste-Decision Support Tool (MSW-DST) modeling of Frederick County's solid waste options illustrate, waste management policies that include energy recovery from solid waste, reduces GHG emissions by reducing or eliminating methane gas emissions from landfills and offsetting the use of fossil fuels used to generate electricity. The electricity generated by the WTE facility can provide a stable low cost renewable electrical energy supply for government operations.

The figure below shows the projected electricity production from the landfill gas and the waste-to-energy projects compared to the County's total baseline electricity usage:

Figure 8: Utilities and Solid Waste – Renewable Energy (Electricity) Contribution Projection by 2024



Recommendations: In the following section the specific recommendations for DUSWM renewable energy projects are presented in more detail.

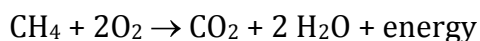
Utilities and Solid Waste Facilities Recommendation 4.1: Continue the landfill gas recovery and electricity generation project which will be able to produce up to 2 megawatts of renewable electricity.

This recommendation focuses on using electricity generated from landfill gases as a renewable energy source for the County. This renewable electricity could either be purchased directly by the County or the County could claim the renewable portion of the electricity through the purchase of Renewable Energy Credits (REC's) from the project.

The science of landfill gas to energy: Landfill gas (LFG) is created as solid waste decomposes under anaerobic conditions in a landfill. LFG consists of about 50 percent methane (CH₄), the primary component of natural gas, slightly less than 50 percent carbon dioxide (CO₂), and a small amount of non-methane organic compounds. As a greenhouse gas, CH₄ is approximately 21 times more potent than CO₂. Therefore the methane portion of each unit of landfill gas represents approximately 95 percent of its greenhouse gas emissions.

In the U.S. municipal solid waste landfills represent one of the largest sources of human-related methane emissions. According to the Energy Information Agency (EIA) in 2006 methane emissions from landfills were slightly less than 146.7 million metric tons of carbon equivalents (MMTCE).⁸

Currently LFG management at the County's Reich's Ford Road sanitary landfill includes active gas extraction and combustion for the closed Site-A landfill. The collection and combustion of the LFG greatly reduces the closed landfill's (methane) greenhouse gas emissions since the combustion of one methane molecule results in the generation of one carbon dioxide molecule, two molecules of water and heat energy. The simple combustion reaction of CH₄, showing the resultant byproducts, is illustrated in the formula shown below.



The single carbon dioxide molecule that results from the combustion of landfill gas represents less than 5 percent of the original methane GHG emission. However, since landfill gas collection systems are not 100 percent efficient some methane is still released from the landfill. Under good conditions landfill gas recovery rates can range from 70 to 90 percent.

Combustion of LFG with energy recovery, in addition to converting the more potent methane greenhouse gas to its less potent combustion byproduct (CO₂), can also offset

⁸ For comparison methane emissions associated with Natural Gas Systems were 150.8 MMTCE. It is important to note that in 2006 methane emissions from all energy sources was 250.4 MMTCE; of which 60 percent of these emissions were associated with the production, processing, transmission, storage, and distribution of natural gas; and most of these fugitive CH₄ emissions (greater than 60 percent) were attributed to transmission, storage and distribution of natural gas.

greenhouse gas emissions from fossil fuel use. For example using LFG to run internal combustion engine generator units, which supply electricity to the PJM RTO, offsets other base load fossil fuel sources of energy such as coal. This results in additional reductions in greenhouse gas emissions.

Landfill gas to energy at the County landfill: After a previous attempt by the County to develop a LFG to energy project failed, the DUSWM requested the Northeast Maryland Waste Disposal Authority (NMWDA) conduct a procurement, which would provide a turn-key gas development project to provide the County's Solid Waste enterprise with an additional revenue stream and/or a renewable energy purchase alternatives.

The estimated 2 MW of electrical power production capacity from the proposed LFG supply, based on a minimum availability of at least 85 percent, could produce approximately 14,892 Megawatt Hours (MWH) per year of renewable electricity. Higher LFG generator availabilities will result in greater amounts of electrical energy as shown in Table 4.

Table 4: Generator Availability and Potential Electrical Energy

LFG Generating Capacity (MW)	Availability (%)	MWH/Year
2.0	85	14,892.0
2.0	86	15,067.2
2.0	87	15,242.4
2.0	88	15,417.6
2.0	89	15,592.8
2.0	90	15,768.0

Landfill gas to energy as a renewable energy source for the County: To evaluate how this potential source of renewable electrical energy could be used to help meet the County's goal, the DUSWM analyzed the County (General) Government and DUSWM FY2008 electrical usage and compared it to the potential renewable supply which is projected to be available through the LFGE development project.

During FY2008 the County's total electrical energy consumption was approximately 40,000,952 KWH. Based on the FY2008 electrical energy consumption values, the renewable electrical energy from the DUSWM LFGE project could supply up to approximately 37 percent of the County's overall (FY2008) electrical energy needs, although at a higher cost than current electrical supply contracts.

Unfortunately the supply of LFG diminishes over time as decomposition of wastes in the landfill progresses. Since the landfill gas generated electricity will continue to decrease as the electrical energy needs of the County increases, this is not considered to be a sustainable source of renewable electricity. By 2018 there will be inadequate landfill gas to power the both 1 MW generator units continuously. By 2026 the gas supply will be inadequate to power the remaining 1 MW generator under continuous operation.

Using FY2008 electrical usage and current (projected) LFG electricity generation values for this analysis, results in better than anticipated projections regarding the amount of renewable energy this project may provide towards the County's goal, since electricity consumption is expected to increase during the same time period that the energy production from this source will be declining. To estimate how this source of renewable energy could contribute to the County's renewable electricity goal beyond 2008, rudimentary electrical energy demand projections for the DUSWM's facilities were completed for the period 2010 through 2030.

Based on preliminary analysis the DUSWM's water, wastewater and solid waste facilities, electrical energy consumption is expected to increase from its current 17,517 MWH per year in FY2008 to approximately 31,860 MWH per year by 2030. At which time the renewable energy production from the LFG system will have diminished to less than 0.75 MW or 6,570 MWH per year. At this future (2030) electrical supply requirement, the LFG project would provide less than 15 percent of the DUSWM projected electric requirements. Assuming a uniform 2% increase per year in the County (General) Government electrical usage from (FY2008), the percentage of renewable energy from the LFG project in 2030 would represent approximately 8 percent of the total projected County electrical consumption.

In August 2008 the County participated in the Frederick Area Cooperative procurement for electric power and received the best pricing from Reliant Energy for a term from November 2010 through October 2013. Based on the original LFG development project schedule, operation of the 2 MW LFGE generating facility could begin as early as March 2010. Based on the contract for LFGE project, the County has the ability to secure this renewable electricity once the Reliant Energy contract ends. At that time the County will have two options. The first option would be to retain the projects Renewable Energy Credits (RECs) associated with this supply, applying these REC's towards the County's renewable energy goal. This may be a lower cost option if the cost to purchase LFG power is greater than the cost purchase power from other sources and the RECs can be purchased for less than the difference in power source cost. The second option would be to purchase a portion or all of the LFG power to supply a portion of the County facilities.

Reduction in non-renewable energy: Although this project will have diminishing returns over the next 20 years, during the first 8 years of the project it should produce approximately 14,892 MWH of electricity annually that is classified as from a renewable source which the County could claim through direct purchase or the retention of the REC's.

Investment: This project is a Design Build Operate (DBO) contract through the NMWDA therefore the DUSWM has no direct up-front costs for the project. Revenues from the project are retained by the County's Solid Waste Enterprise Fund.

(Lead Agency = Division of Utilities and Solid Waste Management)

Utilities and Solid Waste Facilities Recommendation 4.2: Pursue construction of a regional municipal waste-to-energy project that can provide 45 megawatts of renewable electricity beginning in 2015.

This recommendation is focused on the use of electricity generated from the proposed waste-to-energy facility as a renewable energy source for the County through direct purchase of electricity from the project.

Waste-to-energy technology: There are three Waste-to-Energy (WTE) plants in Maryland, combined they produce 110 megawatts of electricity and additional distributed steam energy. As with the landfill gas electricity generation, renewable energy from WTE facilities compete with base-load coal generated power supplied from the PJM RTO, so it can provide the lowest cost “Green Energy” to meet renewable energy goals, associated with reducing greenhouse gas emissions.

Studies done using the U.S. EPA Decision Support Tool have determined that electricity produced by waste-to-energy plants displaces power produced from traditional fossil-fuel power plants resulting in a net saving in the emissions of carbon dioxide. Metals recovered from WTE plant ash results in additional savings in energy and greenhouse gas emissions, due to a reduced need to mine virgin materials. Since municipal solid waste landfills are one of the largest human-generated sources of methane emissions and all methane cannot be captured, processing waste at a WTE facility, as opposed to landfill disposal, also eliminates landfill methane emissions. Mass burn WTE technology on a per ton basis generates substantially more energy than that which can be recovered from landfill disposal and collection and use of LFG.⁹

The Frederick County/Carroll County waste-to-energy project: In December 2006 Frederick County secured the services of RTI International to model Frederick County’s solid waste system using the Municipal Solid Waste Decision Support Tool (MSW-DST). The goal of the modeling was to develop a more detailed and quantitative understanding of the relationships and trade-offs between landfill (both local and transfer to out of state) and the WTE alternative for managing post-recycling municipal waste. After completing its initial report RTI followed up with additional sensitivity analysis, which was completed in July 2008. The results of this modeling show that different waste management alternatives for Frederick County can exhibit a large difference in GHG emissions.

Based on this modeling the WTE alternative results in the lowest (actually negative) net total carbon equivalent emissions compared to land filling in County or using out of state landfills, which have landfill gas energy recovery systems. Based on the MSW-DST modeling, on a greenhouse gas basis, the WTE strategy can reduce/avoid approximately 35,000 to 45,000 MTCE per year as compared to the alternative landfill strategies.

⁹ Reference: Vol. 43, NO. 6, 2009 / Environmental Science & Technology “Is it Better To Burn or Bury Waste for Clean Electricity Generation”

Frederick County began investigating the possible development of a WTE facility as a part of its long-range solid waste management planning several years ago. In 2007 the NMWDA, on behalf of Frederick and Carroll Counties, received proposals for WTE projects. Initial analysis of the proposals showed that a regional WTE facility that would serve both counties would provide the lowest long-term waste disposal cost for each County. In 2008 the Frederick and Carroll County Boards of Commissioners decided to consider a joint regional project that will serve both Counties. The facility could generate as much as 45 megawatts of renewable electrical power, with an availability of 92 percent or better.

In July 2009 the Frederick and Carroll County Commissioners decided to proceed with the development of a regional WTE project adjacent to the DUSWM Ballenger-McKinney Wastewater Treatment Plant. Both Frederick and Carroll County executed agreements with the NMWDA for the regional WTE project. The design and permitting of the facility will take approximately 24 months. Construction and commissioning of the facility would be completed in 2015.

Waste-to-energy as a renewable energy source for the County: To evaluate how electricity generated by the regional WTE facility could be used to help meet the County's renewable energy goal, the DUSWM escalated the 2007 electrical consumption for General Government by 2 percent per year (to 2030), and used the DUSWM projected 2030 electricity consumption. These electricity escalations result in a projected 2030 electrical consumption of 66,619,645 kWh per year.

The proposed 1,500 tons per day (TPD) WTE facilities would generate approximately 45 MW of electricity at capacity. Based on 92 percent availability this will result in the generation of 362,664,000 kWh per year, of which 217,598,400 kWh per year would be available from Frederick County's capacity in the facility.

In the future regulations may require that *only the biogenic portion of the waste, which is combusted as fuel in a WTE facility, receive renewable energy designation.* Should this occur, the biogenic renewable energy portion of Frederick County's 217,598,400 kWh per year value would be between 124,205,167 to 136,608,276 kWh per year, at least two times the County's estimated 2024 annual electrical consumption (59,156,339 kWh per year)

The WTE facility's capability to provide low cost renewable electricity to Frederick County Government operations will allow the County to achieve its aggressive renewable energy goals by 2024 at the lowest possible electrical energy cost. If the County chooses to purchase power from the WTE project it will likely receive a very competitive wholesale rate compared to purchasing power from other renewable power options. It is possible that the County could purchase electricity from the WTE at prices competitive with non-renewable base load rates. However actual costs will not be known until the project is closer to completion.

Reduction in non-renewable energy: The biogenic renewable electricity available to Frederick County from the WTE facility is projected to be 124,205,167 KWH, which is over 3 times the County's baseline electricity consumption and over 2 times the County's projected electricity consumption in 2024.

Investment: The WTE facility will be financed by the NMWDA thorough the use of Revenue Bonds, waste disposal fees and revenues from the sale of electricity and recovered ferrous and non-ferrous metals will fund the Frederick County's costs for the project. At this time it is unknown what the cost differential will be to purchase renewable power generated at the WTE facility compared to conventionally generated electricity. Based on the current downward trend on renewable energy costs and based on the large scale of the proposed WTE facility, it is within the realm of possibility that there will be no premium to the County to purchase this renewable power compared to the purchase of non-renewable power.

(Lead Agency = Division of Utilities and Solid Waste Management)

Utilities and Solid Waste Facilities Recommendation 4.3: *Re-evaluate the option for the installation of a photovoltaic solar technology project in five years.*

This recommendation focuses on the growing practicality of photo-voltaic (solar) electricity production and the possibility the County's Site-A landfill might serve as a location for a large solar panel array.

Previous effort to establish a solar array at the landfill: In April of 2007 Governor O'Malley signed legislation that makes the economic environment for solar power generation in Maryland more attractive (SB 595 2007). The Maryland Renewable Portfolio Standard (RPS) was altered to create a more favorable environment for solar development. The new law created a platform for net metering for solar projects and created an aggressive timeline for the installation of solar energy capacity in the State (1500 MW by 2020).

The Northeast Maryland Waste Disposal Authority (NMWDA) is developing a solar (Photovoltaic) project for Howard County on its closed New Cut Road landfill, where large unused space exists to deploy solar cells. The planned interconnection will occur at nearby Worthington Elementary school. If the school chooses to purchase this power, it would provide a significant percentage of the school's electricity. Frederick County's closed Site-A landfill was included in the NMWDA procurement for the landfill solar projects. Unfortunately no responsive bids were received for the Reich's Ford Road site.

The future seems promising for solar technologies and a project such as this may be viable and economically feasible in 5 to 10 years.

Reduction in non-renewable energy: Because this recommendation is to continue to evaluate the potential for a solar cell project at the closed Site-A landfill in five years, there is no energy reduction projection at this time.

Investment: There is no cost to this recommendation at this time. Any future investment will be determined by the type of project, the costs of future solar technology, the County's standard cost of traditionally generated electricity, and whether the project is contractor-constructed and operated or constructed and built by the County.

(Lead Agency = Division of Utilities and Solid Waste Management)

CONCLUSION

Timeline for Non-Renewable Energy Reductions

The chart below shows the reduction of non-renewable energy use in five year increments if all recommendations in this Plan are implemented. The complete 15 year annual reductions are included in Appendix J.

Year 5 FY2014	Year 10 FY2019	Year 15 FY2024
32.61%	60.87%	66.30%

Projections of costs and savings

A preliminary estimate of one-time costs, ongoing costs and ongoing savings based on implementation of the recommendations is provided in a chart titled “Annual Projected Costs and On-going Savings” in Appendix K. It is important to acknowledge that 15-year projections such as this are done without the benefit of a crystal ball and not all capital costs are known at this time. The further out projections go, the less reliable they are. However, this chart does provide a general order of magnitude to investment and savings that are possible with the implementation of this Plan.

Funding

Funding for energy efficient projects will always be a challenge. However, there are several strategies that can position the County to maximize the funding resources that are available including:

- Grant funding
- Reinvestment of energy savings from completed projects
- Making energy efficiency a priority in CIP projects
- Commitment of additional operating funds when available

Grant Funding

In the past year, more government grant funds have been targeted to energy projects than ever before. Under the Obama Administration emphasis has been placed on energy conservation and renewable energy at the federal level. This directed several large Stimulus Funding initiatives towards energy-related projects. The County was awarded \$659,800 in October 2009 from the DOE’s Energy Efficiency Block Grant program for several conservation and energy efficiency projects. In addition, the Maryland Energy Administration awarded the County \$80,000 in grant funding for energy assessments of County buildings and building system upgrades. County staff in Finance, Management

Services and the Office of Environmental Sustainability will be on the watch for future grant funding opportunities.

Reinvestment of Energy Savings

Over the past 4 years Management Services has documented energy conservation and efficiency initiatives that provide annual operating savings of about \$200,000. The funding represented by these savings was removed from the Management Services budget as a part of balancing the FY10 budget. When the economic situation of the County improves, transferring all or a portion of future savings into an ongoing CIP account for energy conservation and efficiency projects would be one way to fund new projects while providing motivation for continued investment in energy saving projects.

Making Energy Efficiency a Priority in CIP Projects

Because major CIP projects are frequently funded with bond financing, the opportunity exists to finance the additional costs of high efficiency building designs over a 15- or 20-year period. In many cases, this will allow energy savings to pay for the costs of the higher efficiency designs.

Commitment of additional operating funds when available

Some recommendations for reducing the use of non-renewable energy come with a higher operating cost than using traditional energy sources. For example, bio-diesel costs more than standard diesel fuel. In order for this Plan to be fully implemented additional operating funds will be required either from savings resulting from conservation efforts or from additional commitment of funds in the County's budget.

Challenges

With any goal as ambitious and far-reaching as the County Commissioner's strategic goal on non-renewable energy reduction, the County can expect challenges in meeting the goal. Challenges are a natural part of achieving organization change. Identifying and preparing for challenges adds to the likelihood of success. The following are the major challenges anticipated in implementing this Comprehensive Energy Plan:

1. Commitment to the underlying philosophy of the goal - There are several justifications that are promoted for the reduction in the use of non-renewable energy that include:
 - Reducing dependence on foreign oil
 - Conserving natural resources
 - Climate protection
 - Promoting energy conservation
 - Creating a more sustainable way of life

Because not everyone places the same level of importance on these justifications, this goal may be kept in a tenuous situation over the next few years.

2. Continuity of funding - The current economic situation is challenging for both capital and operating funds. This Plan includes significant monetary investment over time to accomplish energy conservation and conversion to renewable energy sources. In some cases there will be a reasonable payback period from the resulting energy savings. However, in other cases the recommendations in this plan will cost the County more money than continuing the status quo. If the County Commissioners goal for non-renewable energy reduction is to be met, additional funding will be required each year during the 15 years of the Plan's implementation.
 3. Competing priorities - Even with strong political support for energy conservation and the use of renewable energy sources, there are many competing priorities for County government's time and money. Whether it is the provision of public safety services, citizen services, or the maintenance of highways and bridges, there are many programs with strong and active advocacy groups that will simultaneously be seeking funding and support from the BOCC.
 4. Changes in world energy markets - Energy markets are in a constant state of flux. In the past, many conservation efforts were motivated by spikes in world energy costs. It is reasonable to believe that the ups and downs of world energy pricing, supply restrictions and manipulations, and world events will have a direct impact on the long-term motivation and commitment of elected officials and citizens to meet the goal of this Plan.
-